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January 24, 1929

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Engineering News-Record

Devoted to Civil Engineering and Contracting

This Material... CONCRETE

First Chapter of an Article
by Nathan C. Johnson

Levee Construction Method and Plant

By Charles S. Hill

Basic Highway Data for Cleveland Region

Reconditioning Wall of Yale Bowl

By Theodore Crane

Supreme Court Decision in Chicago Drainage Canal Case

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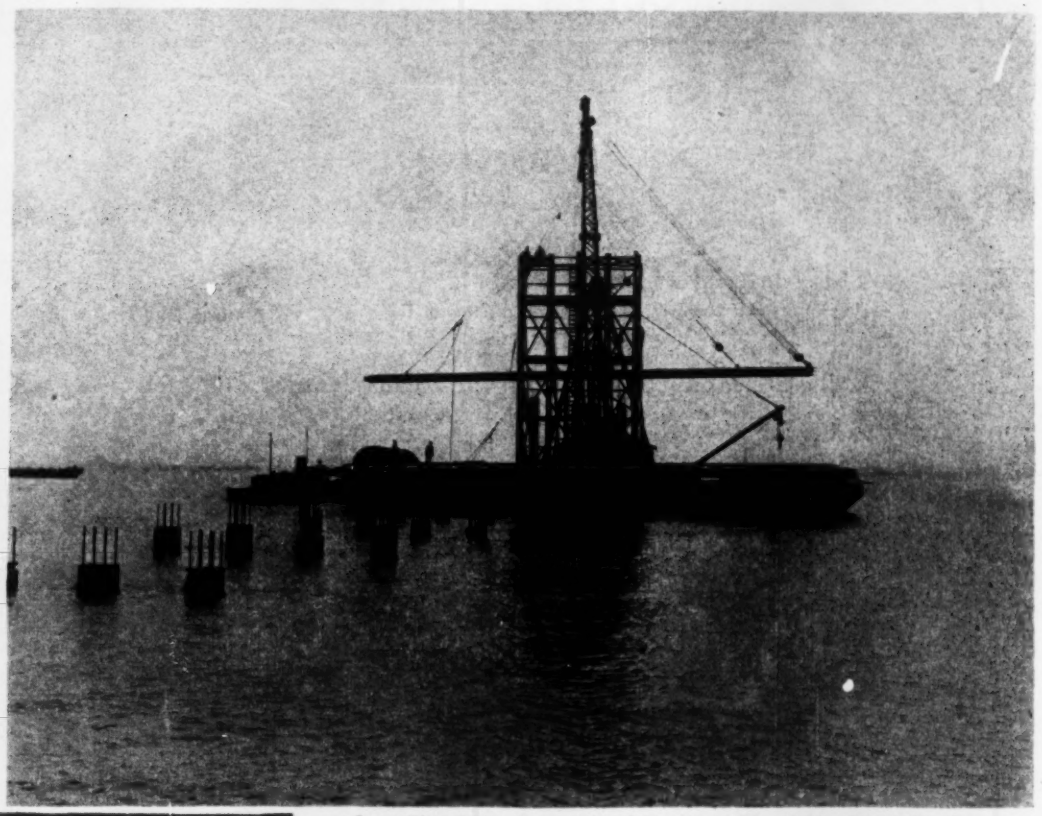

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Ice at Power Plants

TWO novel methods of disposing of anchor ice at power plants were described before the Power Division of the American Society of Civil Engineers at its meeting last week. One was developed as a result of a chance happening, the discovery during the reconstruction of a steam power plant that a portion of the water discharged from the condenser was being drawn back into the intake channel, where it practically eliminated the ice crystals in the colder river water; and the other a means of eliminating ice crystals by melting them with light rays. The first method is effective only for steam power plants and the second, while theoretically effective for either type of plant, will hardly ever be applied to a steam plant because the first and less complicated method is now available. Ice troubles in the intakes of hydro-electric plants are the most serious of all hydro-electric plant troubles and no inexpensive ways of combating them have been found. To date the most effective and least costly methods are constructing a heated enclosure over part of the intake and heating the trash-rack bars by passing electric current through them. The experiments which Professor Barnes of McGill University is now carrying on, in which light rays are used to break down the ice crystals, appear to have great promise in reducing the cost of combating frazil ice.

Planning for the Future

IN THE everyday operations of engineering there is likely to be a sharp and justified contrast between academic and practical views. Necessarily the practical view must govern actual design and construction, and accordingly the theorist's work is apt to be looked on with some disdain. In matters of future planning, however, theorizing assumes a wholly different importance and the practical man's disdain is out of place. Such problems as the development of highway systems require the forward look of the dreamer—though of course he must dream sound and true dreams. It is useless to build a highway system for the facts of today, at the risk of seeing the whole system obsolete before it is completed; and when it comes to the facts of the future, which are the real data on which the solution must be based, we must needs indulge in prophecy. The practical engineer who merely measures and then proportions his structures to those measurements is powerless here. Accordingly, the art of looking into the future and forecasting as truly as possible the measurable facts of tomorrow and next year is something which every engineer may well seek to acquire, at least in some measure. The matter has particularly weighty application to current highway problems, both in cities and in rural districts, since we are in a pace of development that may change the conditions existing at any one point quite radically within a very few years. An excellent example of studies made to furnish a basis for future estimates is presented by the Cleveland traffic survey, of which some data are given in this issue. No doubt its actual revelation of certain important highway facts is the chief feature of the article. But its possible value as indicating how the matter of looking into the future may be approached is also worth consideration.

Gasoline Tax Diversion

AS IS well known, all sources of public money are looked upon with covetous eyes by public agencies looking for larger funds. For this reason it is not surprising that highway money is sometimes sought to be appropriated for other uses. A recent attempt is reported from New Jersey, where a waterway board would like to abstract a large sum from the gasoline tax income for its own purposes. Proposals of this kind are reminders of the watchfulness necessary to guard against diversions of public money and keep the cost and returns of public undertakings in safe correlation. The gasoline tax has no other purpose and excuse than to supply necessary road moneys in reasonably exact proportion to extent of road use. Its merit is that it puts road cost where it belongs and prevents the innocent taxpayer from being punished for the sins of the guilty. But in spite of the compelling logic of such a toll allocation, there will always be predatory interests seeking to divert these special funds to illegitimate uses, instead of going before the appropriating authorities and proving the justice of their claim on general tax funds. Were such attempts to succeed, it would not be long before they would destroy the basis for the gasoline tax completely, and thereby throw the road fund situation back to its old time chaotic state. Just as sound highway development depends on requiring traffic to pay its cost, so it requires that these traffic tolls be not diverted to unrelated uses.

New Levee Practices

A NEW era of levee building on the Mississippi begins with the river-control work undertaken under the act of Congress of a year ago. As pointed out at length in this issue, transportation has become a controlling factor in the problem of finding material for embankment construction. Separate operations of loading, hauling and placing are necessary in much of the new construction. In this situation there lies the largest opportunity for contractors that levee building on the Mississippi has afforded in many years. In the old methods of embankment building, with single-unit outfits which handled directly from borrow into fill, the government construction forces have had the advantage of experience in developing machines and processes and the still greater advantage of trained organizations continued from year to year by their ability to undertake work as they chose. These plants because of their nature are expensive to move from job to job, and therefore they impose a handicap of high plant charges on a contractor uncertain of when

succeeding contracts will follow and of where they may be. Lighter and more portable equipment characterizes the new plant installations, and all of it is general-service equipment which can be employed on any earthmoving operation. In brief, the present transformation of levee building, from a costly, special-equipment operation to one employing machines and training common in excavation and embankment construction, greatly extends the field of possible competition. Contract construction should—if contractors exhibit their accustomed initiative and ingenuity as planners—dominate in new levee building for flood control in the delta lands of the Mississippi.

A Great Question Decided

ABSOLUTE denial of the right of the Chicago Sanitary District to divert water from Lake Michigan for purposes of sewage disposal is the final answer of the United States Supreme Court to 20 years of litigation in its decision of January 14.

The decision is a sweeping victory for the states bordering upon the Great Lakes, all of which except Illinois and Indiana brought suit for an injunction against the diversion of Lake Michigan through the Chicago Drainage Canal on the ground of alleged serious injury to navigation. The significance of the decision is increased by the fact that six states in the lower Mississippi Valley intervened in the suit in support of Illinois, claiming that the diversion is in the interest of navigation in the lower Mississippi River. Altogther 13 states, embracing a large percentage of the area, population and wealth of the United States, were engaged in this litigation, one group claiming damage to navigation on the Great Lakes and the other pleading that the diversion benefits the Mississippi basin.

Opposing interest in the two drainage basins centered also in power development to a considerable extent, because of the decrease in power in the Niagara and St. Lawrence Rivers due to diversion on the one hand, and on the other because of increase in available power at the lower end of the drainage canal. As regards sewage disposal and water supply, not only the Chicago Sanitary District but also towns to the eastward, bordering on Lake Michigan, are concerned. It is also claimed that some towns on the Illinois River below the end of the drainage canal would be adversely affected if the diversion of the water from Lake Michigan through the drainage canal were stopped.

The present decision goes farther than the one by the same court three years ago. The earlier decision merely restrained the district from diverting in excess of the amount granted in the revocable permit of the Secretary of War, but was "without prejudice to any permit which may be issued by the Secretary of War *according to law*". The present decision specifically states what the "law" is. It makes it clear that the Secretary of War and the Chief of Engineers as his advisor, acting under powers delegated by Congress, are bound to prevent injury to navigation. In addition the Court now declares that navigation on the Great Lakes is injured by the diversion, and, while conceding the legality of some diversion through the drainage canal for the benefit of navigation in the Chicago River, holds that the required amount is "negligible" as compared with the amount being diverted under the amended permit of 1925. As the rate of diversion sanctioned by that permit was 8,500 sec-ft. it may be assumed that the warrantable diversion, in the opinion of the Supreme Court, is considerably less than the 4,167 cu.-ft. previously authorized. The Supreme Court justified the 8,500 sec.-ft. only as a temporary measure made necessary to protect navigation from the pollution resulting from defiance of the Federal Government.

Except for a temporary postponement of the date on which the injunction against the Sanitary District of Chicago is to go into effect, the Supreme Court gives no consideration to the claims of the Chicago Sanitary District in behalf of protection to public water supplies afforded by the diversion of lake water and sewage through the drainage canal. The Court presumes in the present as it did in earlier decision that it is quite within the powers of the district, as also within the capabilities of sanitary engineering, to treat the sewage to such a degree that dilution by water from Lake Michigan will be unnecessary, and also that it is the duty of Chicago and the other towns to so treat their water supplies drawn from Lake Michigan as to obviate danger from any pollution that may find its way into the lake.

It should be understood that, possibly barring some remarks in passing, the decision which the United States Supreme Court handed down Jan. 14 is not based on constitutional limitations, but turns upon an act of Congress placing upon the Secretary of War and the Chief of Engineers the prevention of obstruction of navigation. Although the Court says that if it were to uphold any one of three constitutional claims made by the complainant states their prayer would have to be granted, it passes these by and renders its decision on the basis of the Congressional Act of 1899. In passing, however, it refers to decisions of its own which hold that Congress "may not arbitrarily destroy or impair the rights of owners by legislative action which has no real or substantial relation to the control of navigation or appropriateness to that end."

One of the constitutional points mentioned above was whether it is permissible to divert water from one drainage basin into another to the injury of ports in one for the benefit of those in the other. No further direct mention of this point is made, but toward the end of the decision, in denying the claims of the intervening states in the Mississippi Valley, it is stated that "in the absence of direct authority from Congress for a waterway from Lake Michigan to the Mississippi, they show no rightful interest in the maintenance of the diversion." This, however, is far from saying that if Congress were to pass such an act it would be constitutional.

Although in the present decision the Supreme Court said nothing about the international aspect of diversion of water from Lake Michigan, in its decision three years ago it asserted plainly that if diversion is to continue in excess of the 4,167 sec.-ft. it would be a subject for negotiation between Great Britain and the United States in view of an existing treaty between the two countries. This fact combined with the likelihood that if Congress should authorize diversion southward from Lake Michigan for the lakes-to-gulf waterway it would very likely be taken into the Supreme Court seems to leave no hope that there is anything for the Sanitary District to do but dispose of its sewage without use of diluting waters drawn from the lake.

Fortunately a start toward this end has already been made. Years ago the District mapped out a comprehensive program of sewage treatment, and by now a

large part of it is completed, though under the present decision additional treatment will become necessary.

Finally, the present decision settles once for all, and in the negative, the question whether the Chicago Sanitary District can defy, even under the plea of health and sanitation, the authority of the federal government when exercised for the protection of navigation.

Convention Conduct

THE exhibition of road machinery and the attendance of road builders at the annual convention of the American Road Builders' Association in Cleveland, Ohio, last week were larger than ever before. There were also a larger volume and a greater variety of technical reports and papers. As measured by the attendance at sessions, however, these papers and reports commanded scant interest. Except at one or two sessions there was in the convention hall at any time no more than a handful of the hundreds of road officials, engineers and contractors who visited the exhibition of equipment and joined in the section luncheons held daily.

The audience within a stone's throw at Cleveland never occupied seats in the convention halls. It was not because of want of value in the program. There were good speakers and thoughtful addresses. There was variety of subjects. Why then the lack of listeners and the apathy in discussion of the few who sat at the meetings? The question is a vital one, for upon its correct answer depends the possibility of reform, and unless there is reform the function of the convention as an educational assembly will become atrophied.

An obvious answer of course is that the exhibition overshadows the technical deliberations. On a count of attendance, however, it overshadows them a hundredfold, and this is not justified by any comparison. The remedy is to throw a brilliancy onto the sessions which will lift them out of the shadow. The professional activities of the convention must be sold to the 30,000 visitors as the exhibition has been sold to them. The same showmanship must be exercised in making the convention programs interesting as appears on every hand in the exhibition halls.

Mere quality of the papers and committee reports is not sufficient. This must be dramatized by succinct and pointed summary, by attractive illustration and by snappy presentation reinforced by perfect audibility and vision and bodily comfort for those who look and listen.

This suggestion, it is well realized, runs counter to the traditions of technical meetings. But the great annual conclave of the American roadbuilding industry is not a deliberative assemblage of technicians—it is a show. The whole tone of the gathering is that of an exposition. The people meet, as at a fair, to be entertained and interested.

The equipment display spares no means to do both and in doing both at the same time makes itself a source of education. So also the convention may entertain and interest, and yet not fail to carry sound instruction through its committee reports and technical papers. With full publication to follow for the deliberative reader, the listener at the meetings can get the lesson by eye and ear in quick dramatic form.

As they have been conducted, the proceedings are slow and stodgy. To vivify them there will be need of new and skilled showmanship, in place of methods that have been slowly failing for half-a-dozen years.

Broader Outlooks in Concrete

AN interesting story about the famous Yale Bowl is told in this issue by Professor Theodore Crane, of how extensive defects that had developed in its outer wall were made good. His account of the repair procedure will bear close study. But even more attention, if possible, ought to be given to the defects themselves, why they occurred, and how they might have been avoided. It is some years since the Bowl was built, of course. Today, no doubt, concrete constructors work with a surer hand. Besides, concrete has been the subject of a vast amount of study continuously for nearly thirty years. Still, it is well that the causes of the defects in the Bowl be understood fully, so that it may be easier to prevent their recurrence.

The past two or three years have moved the question of quality concrete production into sharp focus. It was long known to be a real question, but it was left to one side by common consent, so to say. The present spirit is more courageous. Nearly everyone today is willing and anxious to find the answer to the question of how to make first-class concrete regularly in commercial practice. Views may differ on whether the art has advanced or stood still during a decade or two, but all agree that we should earnestly seek to make further advance.

Consideration of the subject must begin with a fair appraisal of where we stand—of the extent to which the existing practice of producers comes up to the demands of consumers. By chance, on another page of this issue Nathan C. Johnson undertakes such an appraisal, as the starting point of a discussion of possible betterment of practice. The importance of the task is impressively shown by the magnitude of the operations affected, comprising a total expenditure of two billion dollars each year. This great industry, clearly, will thrive only by standing on the firm ground of unquestioned quality of performance.

Reverting to the great amount of laboratory study that has been given to concrete, we might conclude that the science is well developed, while the practical art is backward. But this is open to question. Practice has progressed greatly, as a matter of fact, while science has not gone very far beyond the ability to make moderately uniform test speciments; it remains unable to give directions for attaining comparable uniformity in the field. There has been real advance, of course, as is illuminatingly shown by the facts on New York subway concrete collated by George L. Lucas in an article to be published shortly; but it is daily brought to the consciousness of all concrete men that too much uncertainty still surrounds quality production under the imperative conditions of field work.

It will be obvious, by looking to other industrial fields and noting their development, that progress is apt to depend on effective co-operation between the scientific and the practical elements. This, in turn, implies a recognition of unity of interest, which has not yet fully evolved in the field of concrete. Recent years have seen it growing strongly, however, and such an organization as the American Concrete Institute can supply an excellent point of concentration. When a thorough understanding of common problems and full harmony of effort shall have been reached between the several units of the practical arts, as well as between the practical and the scientific sides, the outlook for placing concrete on a higher basis of quality will be bright.

This Material—CONCRETE

An Article in Four Chapters

A Discussion of the Vital Problems of the Concrete Industry, Outlining Certain Obstacles to Consistent Quality Production and Indicating a Line of Progress

By Nathan C. Johnson
Consulting Engineer, New York City

I—Difficulty of Standardization

THE concrete industry is so widespread and so huge that anyone who is acquainted with even a few of its various aspects is properly hesitant about stating generalizations as to its necessary and proper conduct. None the less some factors, both economic and technical, common to nearly all operations may be profitably commented on.

In the past 50 years the annual sales volume of commercial or field concretes has grown from an insignificant amount to possibly two billion dollars in the United States alone. Adjudging such proportion as may be proper of these gross sales as total gross profits on the sale and resale of materials, labor and so on incident to the final and completed product, it is quite probable that one billion dollars per annum is the stake in the game for which men, as individuals and as corporations, spend their energies and their talents in striving.

Standardization Not Achieved

Any merchandising operation of this magnitude seeks very properly to have fixed and standard values and methods in its several phases in order that harmful wastes may be avoided. This is a peculiarly difficult end to achieve in the concrete art, by reason of the many variables of one kind or another which enter into making ready for sale an article that is so highly technical. The desire for standardization is legitimate, but any careful examination of things as they are seems to refute the claims born of inward desire which find expression in oft-repeated assertions that "the art is now standardized and perfect."

The more these variables that affect the concrete art are considered the more patent it is that either economic standardization or quality standardization has not been effected in fact. For instance, the commercial or business aspect alone introduces endless economic variations, complications and influences both good and bad, which defy reduction to formula. Furthermore, in the makeup of concrete as a salable commodity many other variables of technical aspect intrude themselves, such, for example, as cement, now made by more than a hundred American companies with an additional amount imported; sand, where, as and how obtained; stone or gravel, as quarried, mined or dredged in many thousand different localities; water "as is" at hundreds of thousands of building sites; weather "as is" from equator to pole; and, not least, the signs-manual of possibly a million workmen, foremen, superintendents, contractors and engineers, all of different temperaments, understandings, talents and perceptions.

But inasmuch as, in the words of Lincoln, " we must whittle our stick with what we have," the innate desire of all men of good will toward concrete to see an effective standardization brought about has caused an extensive apologia to grow up for the continuous and continued employment of those dull tools that the industry used in its early days. Unfortunately this apologia constitutes a large part of the present-day standard. And as a consequence of this there have been overlooked more opportunities for profitable advancement than exist in any of the allied arts where engineering holds sway.

There have been improvements in cements since the early days. There have also been some attempted standardizations of usages; but, for lack either of pertinacity or of principles, these might be better classed as simple acceptances of common-labor usages rather than as standardizations in proper use. There has been a world of admirable research in the mathematics of design, and also another world of laboratory research on various properties of laboratory-made concretes, with chief emphasis on the attainment of strength at early ages.

All of these are steps forward, if for no other reason than their revelation of shortcomings. Let all due credit be given to the many men of brilliant minds who have done this work. It is not minimizing their accomplishments to say that the achievement of the things they have achieved gives better opportunities than ever existed before to go onward.

The Underlying Reaction

Any careful consideration of what may be done toward standardization of the art thus narrows rapidly from problems of merchandising and of finance down to the simple and elementary, for basic principles must come first and the security of the financial side rests after all on the chemical reaction or reactions between cement and water and the utilization of that reaction in commerce.

In a scientific sense and as of absolute data, little is known about this reaction between cement and water. But one fact of tremendous importance is known: Whenever portland cement is wetted with water it will first be a plastic, then will lose that plasticity, or become set, and later will become rigid, hard, resistant. In this process it will bond in with itself sand and stone, good or poor, in quantities greater or quantities less, to form an exceedingly useful solid, well suited to a wide variety of utilitarian purposes.

This simple fact is the basis of the whole art. In our structures we rarely if ever have outward evidence of the great strength produced by wetting cement. But laboratories, by means of small-sized pieces of about 50 lb. each, broken in complex arrangements of scale beams and applied power, make evident that strength is achieved and that the achieving of this strength has certain limitations and characteristics. These characteristics, interwoven with mathematics, with knowledge of the end or ends to be served by the structure so that form or shape

is determined, together with the manual operations of drafting, constitute broadly that phase of the art which is known as design; and collateral with design go specifications to govern the field-embodiment of the design in the structure.

Strength Not Fully Utilized

Unit strengths, then, as determined by laboratory tests and laboratory rules are the foundation rock on which the art rests. Too often they are the rock on which the art splits, for they are currently assumed to be of a potency which may not be granted without qualification.

The difficulty of standardization by sole reference to strength lies in the fact that, due to low stresses allowed and high factors of safety required by codes, sufficient strength for almost any commercial needs is easily and automatically obtained by the mere wetting of cement.

Presumptively, of course, a mere wetting of the cement in the figurative sense used above is prevented by the specifications which are written as a guide and as a regulator of worth and quality; for the engineer and architect, as representatives of the owner, are greatly concerned with this worth. Presumptively also the provisions and governing clauses of these specifications are not only wise but necessary, inasmuch as, if such standardization of these specifications as exist is a proper standardization and based on facts, the rules of conduct, the materials, the quantities of materials and so on described and prescribed therein are the only rules, materials, quantities and so on that may be followed and used with the achievement of proper result.

Right at this point begins an absurdity and all too often a division of interest as well as a belying of any standardization in fact.

Contractor and Engineer

The contractor knows a thing or two from long experience in actually working with concrete and the separate materials of concrete. He may know as fact that some of the provisions of the contract and specifications are impossible of commercial realization—such a requirement, perhaps, as maintaining a definite grading in the sand or in the stone throughout hundreds and thousands of cubic yards. Furthermore, his is the actual grief of the actual work, in fair weather or foul, day in and day out, with the matter of costs down to the fraction of a cent forever in the balance and spelling, perhaps, welfare or ruin for him and for his on this one job.

Fundamentally the contractor's position is that he is to deliver a structure complete and entire; that this delivery is secured not only by his own resources, but by a surety bond as well; and that if he can achieve this result or an estimated equal by an alternative means or method as well as by the specification method, then he is entitled to this option.

In support of this position stands the universal fact that with substantially any mixture of sand, of stone, of cement and of water, a structure will be had, because of the marvelous ability of wetted cement to liberate power —the power to bind in sand and stone and the power to resist stress—and that, even with great abuse, the low stresses permitted by codes and utilized in design will safeguard all but the most impossibly bad from actual collapse.

Anyone who contacts with constructors is impelled to admiration for the painstaking care and the patience and persistence with which, as a class and as a rule, they carry out their work. And in no sense of derogation, but only as investigation of things as too often they are, is it mentioned here that any close contact with commercial work must bring the conclusion either that our standards are wrong or that they are worse than warped or short-sighted, for there are many provisions current as standard which are not only violated constantly in fact but violated in principle as well, yet with the achievement of astonishingly good results.

Assuming one provision violated of necessity, why not violate another?

Here we stand at Armageddon. If our written art is even reasonably an embodiment of science, then science and the written art will prevail. If the written art is only a pseudo-science, then commercialism will prevail and uneconomic arbitrariness will go out of the window.

The facts are that, in such a situation, any uneconomic specification can and often does speedily become a futile thing and the engineer or architect becomes a mere figurehead if the process of arguing out of specifications—technically known as "crying"—be carried out with sufficient skill, pugnacity and finesse. And "crying" is rarely if ever done as a pastime, but rather with the intent and end of avoiding provisions that are commonly assumed necessary to the successful prosecution of this art and that reputedly are a part of its standardization.

Are Our Standards at Fault?

Whether the contractor is right or wrong or whether the engineer or architect is right or wrong is, at first blush, of little relative importance, since with either good specifications or bad specifications, or with good use or bad use, cement always does its little stunt with water, sand and stone; the forms are filled and a structure is had as per pictures drawn and designs made.

But what is of importance in this recurring situation is that known or reputed successes in deviating from the reputedly fixed art have not only achieved apparently good results and thereby discredited to a commensurate degree the dicta of congresses of best minds as embodied in standardized specifications but they have further stultified the progress of the art along broader lines and have exalted individualism until this individualism rampant has come to verge on chaos.

This situation should be changed for the interests of all concerned. If standard specifications are either incorrect or inadequate, they should be corrected and made adequate. If standard provisions of the past may be avoided with impunity, the best method known or discoverable for obtaining a given result should be studied, evaluated and as soon as possible made standard in published specification, in order that those who must get or acquire their knowledge in condensed form from others may know that a certain alternative method, proposed, let us say, in a "crying bee" as a substitute for the method specified, either is allowable in so far as it will achieve proper results, or else that such a method or procedure is not allowable without severe penalties being incurred in the final result.

Reasons for Revision

By this process we shall, in reality, achieve a standardized art and avoid the wild swings in bidding that today cause millions of dollars of ultimate annual loss. When all bidders learn that all alike will and properly may be subject to the exact terms and wording of a specification and that these terms are sensible, economical and will lead, with the exercise of normal intelligence in the conduct of a job, to a satisfactory and economical result, then we may hope not only for more rational

basis for engineering and for construction but also for more profits for all concerned.

From the standpoint of the doctrine that any mixture containing cement is bound to be both perfect and permanent, this, of course, is rank heresy. But in contemplating this heresy it may be well to remember that the automobile of 1929 would have been not only heresy but even witchcraft as compared with the auto of 1910. How curious, by the way, were those "finished, final ultimate and fixed" autos of 1910. Yet not only is the concrete of today no different from the concrete of 1910 but it is no different from the concrete of 1880, save in the magnitude of individual projects.

Concrete and its making are stated to be the only branches of engineering in which the science *per se* has remained without substantial advances. Advances in quickness of hardening of cements have become general within the past year under force of competition, but it is as yet too early to evaluate these cements in all their aspects and determine whether or not there is a penalty to pay in, for instance, endurance. Fine advances have been made in the machinery for handling the materials of concrete, but few advances in controlling that fundamental reaction between cement and water which results in those inconceivably great outpourings of power that lock together sand and stone into structures that are useful to man.

Points That Need Explaining

If any one doubts this, let him explain, if he can, why there is so commonly a wide disparity of results observable between one concrete and another. If it be denied that such disparity does or can exist, let him who believes the art *as is* to be a sufficient art, so governed by definite laws as to be declared a fixed art, go before any court where today one difficulty with concrete or another is being adjudicated as to responsibility. Let him there explain in open and precise terms why this floor was excellent and that one warped or cracked or scaled; why this caisson failed and that caisson did not, and let it furthermore be done on such precise and definite knowledge that the judge and jury may understand—and, not least, that his statements may not be successfully controverted by others.

These things, too, are heresies. But in judging any heresies it is necessary to examine first the canons of faith and judge their merit, or lack of merit, their sufficiencies or shortcomings. If we have indeed a science and not mere dogma, this should not be difficult to do.

One thing is certain at the outset. The canons of our art begin in the laboratory. In that cloistered seclusion, with fixed conditions of temperature, moisture, materials and so on; with economics not a factor; with beautiful and powerful mechanisms installed for every purpose and with "Ethics" beginning with the letter "E" instead of the letter "X"; and with no storms, or strifes, or anxieties, or unions, or bills payable, or weather, or unskilled labor to contend with or worry over, results of one nature or another have been accumulated, tabulated, plotted, thought over and interpreted, until out of it all have come certain things that are the basis of our articles of faith.

In these laboratories cement and water do their little dance together, both with and without sand and stone, much as they do in the field and result in a hard, rocklike substance or substances that show less strength or greater strength when tested in delicate and sensitive machines according as one variable or another is shifted about.

The same phenomenon taking place, to all outward seeming, in both field and laboratory, the results and dicta of the laboratory are taken out into the icy or torrid or gentle blasts of the field and clapped on as applying equally to both. At times, too, the field is taken back into the laboratory, *but only under certain rigid restrictions.*

But inasmuch as even the most unseeing has, at times, to recognize that the behaviors of concrete allowed to remain in the secular life differ materially from those of concrete removed to more peaceful surroundings, and inasmuch as these philanderings in worldly surroundings cause worry and expense, it behooves us to learn why, and to determine whether the world itself, admittedly sinful, is responsible or whether the canons are too intolerant or too narrow to be lived up to.

That this examination is both reputable and worthy may not be gainsaid. The need is too pressing to admit of lack of thought or narrow prejudices barring the path. Nor, on the other hand, may any extravagance of idealism, unmindful of necessary commercial policies, be permitted to lead us into any unsoundness of thought or recklessness of expression.

We may not forget, for instance, that concrete is already doing a wonderful work and filling a broad industrial need so great that inability to get it or to have it available at need would verge on national calamity. We may not forget that this concrete is produced under all the stress and strain of every adverse condition that may be imagined. But at the same time, we may legitimately hold that an orderly art, derived from fully sound as opposed to what may prove to be unsound or immature conclusions, would bring better satisfaction, broader use and usefulness and a greater value per dollar expended than can be the case where everyone is become an expert in concrete, as seems to be the case today.

So may we and indeed so must we examine the doctrinism that, by one pressure or another, has resulted in the binding of men to the wheels of one commercialism or another. We must so examine this doctrinism that no disorder shall be created, yet so thoroughly that any attempt, by one means or another, to reduce initiative or intelligence to a mere headquarters formula shall be an impossibility.

Let Us Investigate

This investigation need not, and most obviously should not, be an abstract or polemical thing, comparable to the medieval question of "how many angels can dance on the head of a pin." It can be and must be rugged, common-sense thinking, closely allied to the practice of the art as it is. The dollar sign must be present as well as the interaction of atoms, molecules and the handmaidens and handmen of each.

Such an investigation should be profitable. It cannot help being profitable; and if rightly conducted there will be inspiration and pleasure as well as profit to be had by anyone who is at all of an open mind.

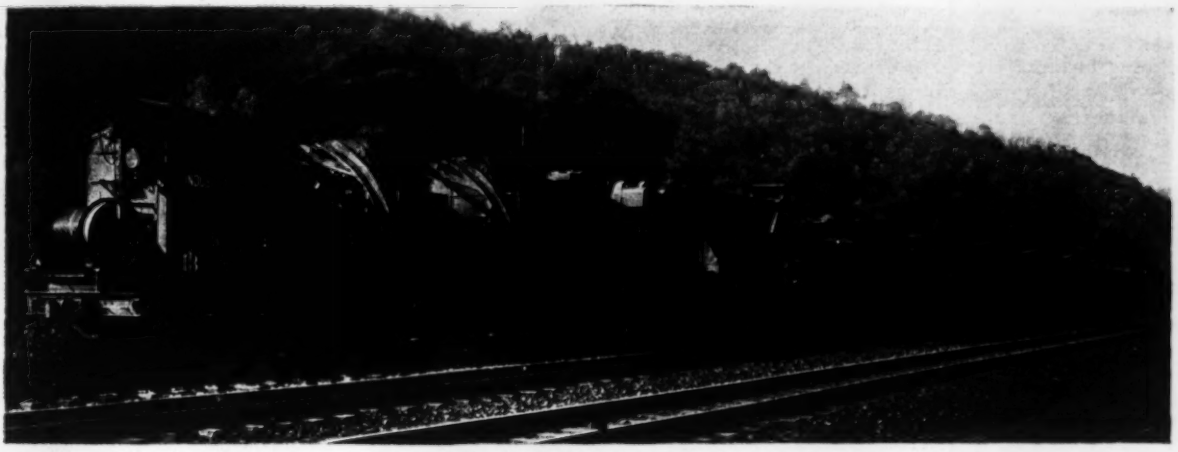
Inasmuch, then, as unit strength is *the* basic assumption of all design, and inasmuch as this same unit strength, apparently proved abundantly by both the laboratory by itself and also when the field, in specimen, is moved back to the laboratory, it is both wise and illuminating first to examine those things which we have as heritages from our forefathers, to determine what there may be in them of overlooked values that will bring us a step, at least, nearer standardization.

The second chapter of Mr. Johnson's article will appear next week.

Ballast-Cleaning Machine on the Pennsylvania Railroad

Grab Buckets and Screens on Cars Hauled by Cable—Cleaned Stone Returns to Track—Operating Results

ECONOMICAL methods of removing the dirt and dust that accumulate in stone ballast have been studied by large railroads for several years, and in order to reduce the expense of doing such tedious work by hand mechanical devices have been tried in some cases. One of the latest developments is a ballast-cleaning machine which digs up the ballast between the tracks by means of grab buckets and passes it through screens to separate the stone from the dirt. This machine has been put in experimental service by the Pennsylvania Railroad, which has previously tried a pneumatic or vacuum-cleaner machine for the same purpose. In the accompanying illustration is shown the new machine, with its two grab buckets and the cable drum by which it hauls itself forward. Behind it are six coal cars to receive the dirt delivered by a series of conveyors. A spreader car and a caboose complete the train.



BALLAST-CLEANING TRAIN

First car has grab buckets and cable haulage drum. Second car carries screens. Portable conveyors deliver dirt to freight cars in rear.

The ballast digging and cleaning machinery is mounted on two steel-frame cars, the first of which has also a 300-kw. generator driven by a 300-hp. gasoline engine and furnishes current to operate the motors for the various mechanisms, including an air compressor for the cleaning apparatus. On one side of this first car are two ½-yd. grab buckets moving laterally on curved guides, so that they do not swing free and cannot foul trains on the adjacent track. With the machine at rest, the operator lowers the first bucket, which has a spread of about 8 ft., and picks up the ballast in half the width of the space between ends of ties. It then rides up on the guides to discharge its contents into a hopper. As the machine moves forward about 7 ft. an adjustable plow throws the ballast inward from the outer half of the track space, so that it can be picked up by the rear bucket. In this second position the forward bucket makes another cut, and the operations are repeated. As the bucket edges have teeth, there is no need for loosening the ballast in advance.

From the receiving hopper, the ballast is fed to an inclined bucket conveyor and is delivered to a similar conveyor on the second car, which in turn delivers it to the hopper of a set of screens through which a blast of air is maintained. The clean stone passes to a hopper, from which it is returned to the space between the tracks by a chute having an opening about 7 ft. long, parallel with the rails. A spreader or templet dresses it to shape. As the ballast is between the tracks, no tamping is required. The dirt from the screens falls upon a belt conveyor on an inclined boom which may discharge into a freight car at the rear or may be swung laterally to discharge the dirt outside of the track. In cleaning a long stretch of track, which is closed to traffic for this purpose, several freight cars may be attached, as shown in the accompanying illustration, each being equipped with a portable belt conveyor on a boom with hopper at the receiving end. This arrangement gives a large storage capacity where dirt cannot be disposed of conveniently.

The ballast-cleaning train is not hauled by a locomotive while at work, as the speed is very low. After being taken to the point where work is to be done, the locomotive is uncoupled and run ahead about 500 ft., where it is stopped and the brakes are set. Attached to the locomotive is the end of a cable on a motor-driven drum at the head of the machine, the machine hauling itself forward in steps of about 7 ft. and at the rate of about 4 m.p.h.

Ballast in the cribs or spaces between the ties is dug out by hand in advance and piled in the space between tracks, to be picked up by the buckets. On account of the large number of men required for this operation it has been accomplished only on a portion of the trackage covered by the machine. If the cleaned ballast is to be returned to the cribs, it is handled by men with ballast forks, but usually it is left only in the space between tracks. The machine is used only for stone ballast and on multiple-track lines, as it would not be good practice to use it for cleaning only the shoulders of single-track lines.

This ballast-cleaning machine, which was designed jointly by the Industrial Brownhoist Corporation, Cleveland, Ohio, and engineers of the Pennsylvania Railroad, has been operated on 135 miles of track. In a working day it covers about 7,500 ft. of track, handling approximately 2,000 cu.yd. of ballast.

Public Problems Considered by Engineering Council

Relation of Civil to Military Engineers to be Studied—Favor National Hydraulic Laboratory—State Legislation on Dam Construction—Constitutional Amendment as to Interstate Waters Proposed

By Paul Wooton
Washington Correspondent, Engineering News-Record

UNQUESTIONABLY the feature of the annual meeting of the assembly of American Engineering Council, held in Washington Jan. 14 and 15, was the unanimous determination evidenced by those in attendance to clarify the relationships between the civilian and military engineers. While the discussion of the matter resulted in sharp criticism of the attitude of the army engineers toward the civilian engineers, it was emphasized that the study is going to be conducted in a dispassionate and constructive manner, in the hope that the relationships between the two bodies of civil engineers can be co-ordinated in a way that will permit them to pull together in the future without friction.

The selection of the committee of three that is to make this study will be made with great care so as to insure the best possible report.

Policies of the army engineers came in for criticism at the assembly's annual dinner. Senator Harry B. Hawes, of Missouri, pointed out that there are 150,000 engineers in the United States and yet "if you are not a general, or a colonel, or a major, you cannot do much public work in the United States." He criticized the policy of changing at frequent intervals the officers in immediate charge of engineering projects. "Our great American nation," Senator Hawes continued, "when it undertakes to control our flood waters, should call into its counsel some of the civilian talent to co-operate with the army engineers. At the present time the civilian engineers are debarred from the exercise of their skill in connection with much of the government's work."

The effort to secure the passage of Senator Ransdell's bill, providing for the establishment of a national hydraulic laboratory in the Bureau of Standards, was made one of the major objectives of the organization. The bill has passed the Senate, but is being held up in the Committee on Rivers and Harbors of the House of Representatives. Importance was attached to this legislation because of principles involved, as well as the need for such an institution. The general understanding is that the Rivers and Harbors Committee in failing to report the bill is being influenced by the Chief of Engineers. This was cited as typical of the disregard in the Corps of Engineers for engineering thought originating elsewhere. It was contended that the army engineers now have authority to establish their own hydraulic laboratories and should be willing to allow other agencies of the government to establish a laboratory in the Bureau of Standards, at which hydraulic and related experiments could be carried forward. Senator Ransdell, one of the speakers at the dinner, frankly urged the members of American Engineering Council to exert their full influence on the Committee of Rivers and Harbors in an effort to secure favorable action on the hydraulic laboratory bill before the close of the present short session of Congress. A committee composed of Farley Osgood, of New York, I. E. Moultrop, of Boston, and Charles E. Penrose, of Philadelphia, was designated to take up the matter with Chairman Demsey of the Rivers and Harbors Committee.

Important amendments to the constitution made at the meeting put into statutory form policies that have been the practice throughout the life of the organization. These amendments make it certain that the work of the Council will be confined to activities which have the endorsement of the great preponderance of the membership. The provisions of the amendments were set forth in last week's issue.

The assembly approved an addition to census information which would show the number of man-hours worked in manufacturing establishments. This question now is being discussed with census officials.

The assembly in no way altered the existing policy with regard to grouping of engineering activities in a single department. While there is no change in the official attitude of the organization toward the Public Works Department proposal, it was evident at the meeting that many of the delegates favor some modification of that effort.

Proposed endorsement of legislation providing for the creation of a Federal Communications Commission met with opposition and was referred to a special committee for study and report.

A committee consisting of Gardner S. Williams, Ann Arbor; Leroy M. Pharis, Duluth; Allen Hazen, New York; L. F. Harza, Chicago, and Charles Gilman Hyde, California, was appointed to give consideration to legislation looking to the supervision of the construction of dams. In cases where state legislation is contemplated an effort will be made to assist in the drafting of the measure so that uniform laws looking to the safety of such structures may be enacted.

Adoption of an amendment to the Federal Constitution to provide the powers necessary for the control and administration by the Federal Government of interstate waters was suggested to the Assembly by Arthur E. Morgan, president of Antioch University. As a result of his recommendation steps already are being taken looking to the introduction of the necessary legislation. In his address Dr. Morgan explained the difficulties arising in connection with the projects involving interstate waters. He pointed out that many important projects cannot be carried into effect under present conditions, due to difficulties of securing agreements among the states concerned. He cited an example in Pennsylvania where the construction of a large reservoir to furnish condensing water for steel mills is greatly in the public interest, but under the inadequate provisions of the constitution of the State of Pennsylvania it has been impossible during a period of twenty years to condemn the right-of-way for such a reservoir.

"An amendment to the Federal Constitution," Dr. Mor-

gan said in the course of his remarks, "may seem impossible, but I do not believe that such is the case. For fifty years we have been inhibiting and dwarfing many projects because such an amendment did not exist. It may take fifty years more to get the amendment, but the sooner we start the sooner we will arrive at fullfillment."

Building Sewer Manhole With Radial Concrete Blocks

SEWER manholes built of concrete blocks cast to a given radius, with tongue-and-groove ends and with special batter blocks furnished for "drawing in" the tops prior to placing the standard manhole frame and cover, are being used in a number of Middle Western cities, according to T. A. Day, of the Portland Cement Association. Some 50 such manholes have been built in Lincoln Park, Chicago. Peoria, Ill., has included about 500 concrete block manholes in its $750,000 sewer project which was put under way last year. Racine, Wis., built about 300 concrete block manholes and catchbasins in 1927. Gary, Ind., has been using such manholes during the past eighteen months and is reported to have been so well satisfied that all contractors are now requested to consider the use of concrete blocks in place of brick or poured concrete.

In addition to these cities, the following list, though incomplete, includes some of the other cities that are using concrete blocks: Elmhurst, Dolton, Lansing, Glen Ellyn, Downers Grove, Waukegan, Berwyn, Bellwood, Niles Center, Highland Park, Tessville, Norton Grove, North Riverdale, Villa Park, Des Plaines, Richmond, Wheaton, Mount Prospect and Westchester, Ill.; Spencer, Des Moines, Clear Lake, Fort Dodge, Sioux Rapids, Correctionville, Newton, Hinton, Mason City and Marion, Iowa; Waseca, North St. Paul, Mankato, Wanamingo, Faribault, Mabel and Jordan, Minn.; Kenosha and Phillips, Wis.; Terre Haute, Ind., and Caspian, Mich.

The accompanying illustrations show one of the manholes in Lincoln Park, Chicago. Each block has an inside radius of 18 in., is 6 in. thick and 8 in. high. A vertical tongue at one end of the block and a corresponding groove at the other are important features. Eight blocks are required to complete one course of a manhole with inside diameter of 36 in. In corbeling or "drawing in" the top portion of this manhole two courses of units, known as batter block, are required. The first row of eight units reduces the inside diameter from 36 to 30 in., while the top course decreases the diameter from 30 to 24 in., thus providing the proper sized opening to receive a standard manhole frame and cover. In case the manhole is larger than 36 in., additional courses of batter blocks are added. For example, for a 48-in. manhole the same two courses of batter blocks as used on the 36-in. manhole are placed upon two additional courses of batter blocks, first reducing the cone to 42 in., second to 36. Manufacturers now produce units to build manholes of 30-, 36-, 42- or 48-in. inside diameters.

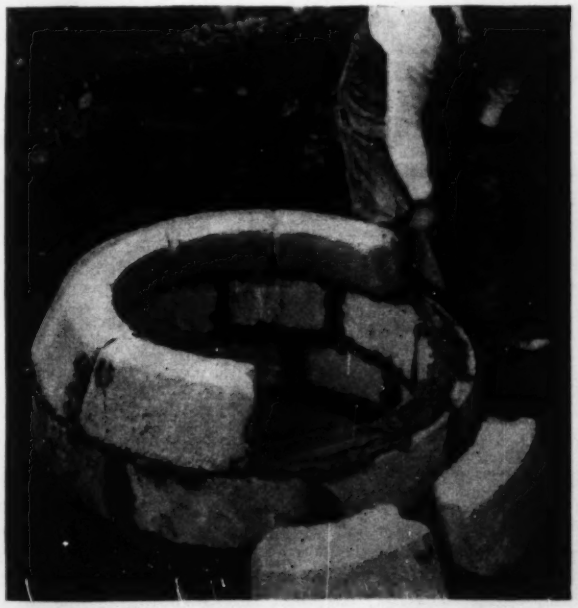


FIG. 1—PLACING BATTER BLOCK TO DRAW IN TOP OF MANHOLE

FIG. 2—FINISHED CONCRETE BLOCK MANHOLE 36-IN. INSIDE DIAMETER, LINCOLN PARK, CHICAGO

Blocks for various-sized structures are plainly marked. For example, the units produced by one manufacturer for a 48-in. structure bear the mark, "48–6," meaning that the wall thickness is 6 in. and that the units fit into a 48-in. circle. The batter blocks for each course are usually identified by a certain color of paint; those that decrease from 48 to 42 in. are plain; those that decrease from 42 to 36 in. are marked with a spot of red paint; those reducing from 36 to 30 are marked black; while those decreasing from 30 to 24 in. are marked green.

Submerged Contact Aerators at Jacksonville —Correction

In a letter to the editor in the Jan. 3 issue from H. L. Thackwell there was an error in next to the last paragraph on p. 36. The last sentence of that paragraph should haver read as follows: "Straight activated sludge of one to three hours aeration would be just as satisfactory for a preliminary treatment."

Reconditioning the Wall of the Yale Bowl

Famous Structure Fourteen Years Old Disfigured by Surface Deterioration and Contraction Cracks—Surface Defects Cut Out and Patched, and Cracks Converted Into Joints

By Theodore Crane

Associate Professor of Building Construction, Sheffield Scientific School, Yale University, New Haven, Conn.

THE Yale Bowl was built about fourteen years ago, being virtually completed in the fall of 1914. It was one of the first of the large concrete stadiums and has a seating capacity of 76,000. Because of the peculiar design of this huge structure, lying partly below and partly above the level of the surrounding ground, it was necessary to construct a retaining wall 9 ft. high around the entire perimeter of the embankment. This wall, approximately 3,000 ft. in length, comprises 118 panels, separated by pilasters and pierced by 30 portals.

The Bowl has, on the whole, been a successful structure. Many serious problems were solved at a period when the technology of concrete was far less understood than it is at the present time. The upkeep has been low. The expense of even the rather extensive repairs now under way, if divided over the period of use, would show but a low percentage on the first cost. In fact, with the exception of serious cracks adjacent to portal entrances and considerable surface disintegration on the steps forming the bleachers, the interior is in excellent condition.

The chief source of trouble has been the retaining wall surrounding the embankment. The conditions there became so serious that remedial treatment was deemed advisable. As in every case of this nature, the first step was to determine the causes of the trouble, evidence of which was only too apparent on the exterior of the wall. The investigation developed the following information:

Condition of the Wall—The wall, a gravity section (Fig. 3), was cracked all the way through in approximately 100 of the 118 panels. These cracks occurred with but few exceptions quite near the pilasters; although ragged in appearance, they were, in the main, fairly vertical, and the plane of rupture was approximately perpendicular to the face of the wall. The chief cause of this failure was the absence of proper means to provide for volumetric changes in the concrete due to variations in temperature and moisture. Joints had been designed between pilasters and panels, but the material used to break the bond, a thin coating of black mastic, failed in its function; the joint held and the panel broke. These cracks were taking in water from flooded gutters on top of the wall, and disintegration was under way.

Although the concrete was of fair quality, it was interspersed with rock pockets, the aggregates showing evidence of considerable segregation. The porous portions of the wall acted as reservoirs for the storage of rain water, which was constantly seeping out on the face of the wall and causing unsightly stains. Judging by the thickness of laitance at pour lines, it would appear also that the mixture as delivered to the forms was too wet for that class of work. Failure to remove this laitance, accumulations of which formed after each pour, resulted in lines of weakness extending entirely through the wall and providing excellent channels for the percolation of water from the flooded gutters and moist backfill. This was particularly the case immediately below the coping, where an undisturbed layer of laitance nearly ¼ in. thick occurred for long sections of the wall.

The concrete gutters along the top of the wall were not graded to the drains. Water, trapped in some sections to a depth of more than an inch, gradually soaked into the porous concrete and worked its way to the face of the wall, assisting the process of disintegration. Furthermore, no weep holes were provided in the original design. Presumably it was expected that a heavy sod would minimize the amount of water finding its way through the surface and that the porous subsoil would take care of whatever moisture passed into the fill back of the wall. Unfortunately, however, it has been impracticable to obtain a dense sod, and the weep holes, drilled as part of the work of reconditioning, actually function after heavy rains.

Strange as it may seem, the tie wires used for retaining the forms in place were cut off at the surface, stubs

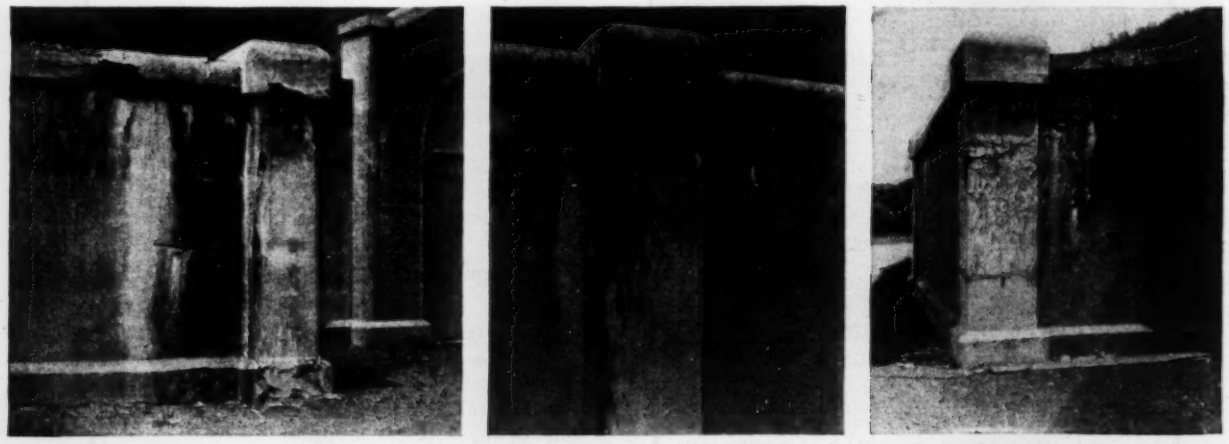


FIG. 1—CHARACTERISTIC DEFECTS OF YALE BOWL WALL

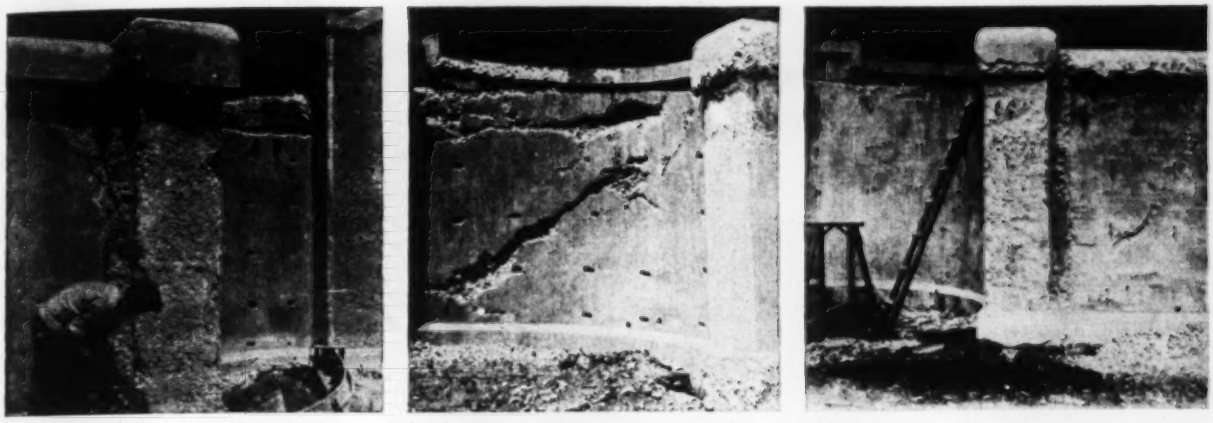


FIG. 2—REMOVING DEFECTIVE MATERIAL AND PREPARING RECESSES FOR CONTRACTION JOINTS
Note iron stains due to cut tie wires, in third picture.

being left exposed. This, of course, resulted in spotting the wall with rust and localized spalling of the surface as oxidation ran back along the wires.

The surface finish was of two distinct types. The panels, which apparently had been sand-floated, remained in excellent condition. The pilasters, however, had been given a coating of rich consistency applied with the steel. In some cases this had spalled off, as one would expect it to do, while in other places the bond with the base was still perfect, although the surface was thickly laced wth characteristic spider-web cracks.

Methods of Reconditioning—Having completed a diagnosis of the trouble, various remedial measures were considered. A suggestion was made to cover the entire front of the wall with a brick veneer. The idea of removing about 3,000 cu.yd. of earth back of the wall and applying a complete membrane waterproofing received consideration. During the summer of 1927 trial repairs were made upon one section. Based on the results obtained at that time, details and specifications were prepared for a complete reconditioning. These formed the basis for a contract awarded in June, 1928.

The substance of the plan was frankly to accept the structural cracks and to use them as contraction joints. It was originally thought necessary to cast new concrete

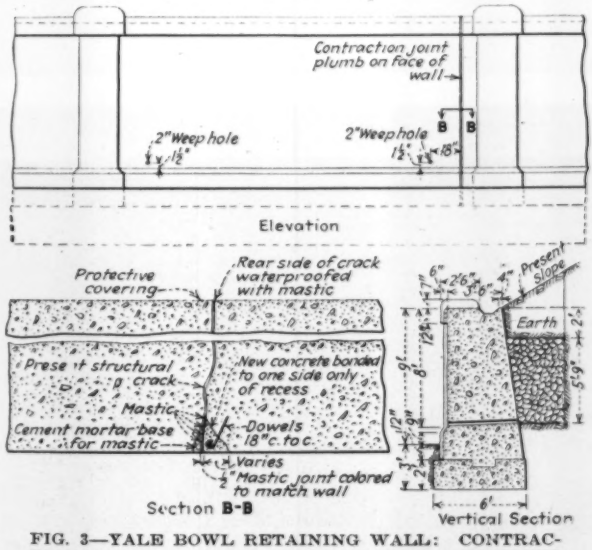


FIG. 3—YALE BOWL RETAINING WALL: CONTRACTION JOINTS FORMED FROM CRACKS, AND WEEP HOLES DRILLED NEAR BASE

on each side of the joint, but the character of the cracks permitted merely smoothing the surface on one side, thereby saving the cost of double forming (see Fig. 3).

Converting Cracks Into Joints—The first operation was cutting back the concrete from the face of the crack to a sufficient width and depth to permit placing a vertical joint (Fig. 3). In other words, if the trace of the crack on the exterior face of the wall was to be transformed into a plumb joint, the distance that it was necessary to cut back depended upon the amount which the crack departed from the vertical. An electric hammer was used in this work, the openings being undercut where possible. All loose materials were removed and the chipped surfaces cleaned by means of compressed air.

The next step was to apply a coat of mortar against the jagged surfaces of the recess, on one side of the crack, in order to form a comparatively smooth face to receive the mastic which was to serve as a joint filler. This latter was then applied in the form of a layer of elastic cement ("Vulcatex") about $\frac{3}{8}$ in. thick, and was protected by a thickness of impregnated cotton drills such as is used for membrane waterproofing (Fig. 4). The mastic was worked into the structural cracks along the rear of the recess, and extended to within 1 in. of the front of the wall, the face joint being formed by a strip of wood $\frac{1}{2}$x$\frac{7}{8}$ in., which was replaced by elastic cement after the adjacent concrete had been poured. Having thus obtained a complete line of demarcation, the remainder of the recess was filled with concrete, poured in two lifts, and doweled to the old material (Fig. 4).

Other Surface Defects—As the work on the structural cracks progressed, the wall was inspected and tapped in order to disclose rock pockets, laitance courses or places where the surface had separated from the base. These sections were then cut out by electric hammers, care being exercised to avoid V-shaped recesses, to start the cuts at the face of the wall with a shoulder at least $\frac{1}{2}$ in. deep and to have a clean, jagged surface to receive the material forming the patch. The mortar for this part was mixed one part portland cement to two parts by volume of Cow Bay sand. All work was finished under wood, no steel trowels being used for that purpose. The recesses were washed with an acid preparation and thoroughly rinsed before filling. At the same time all tie wires were cut back a distance of at least 2 in. from the face of the wall, and the holes were treated in the same manner as the larger openings.

As part of the replacement of defective work, it became necessary to rebuild the upper portions of several

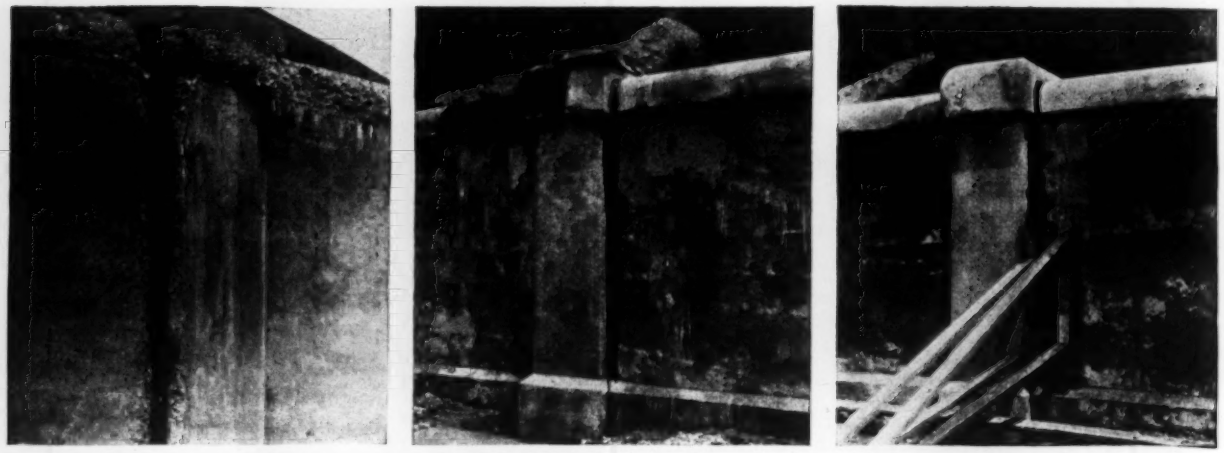


FIG. 4—PROGRESSIVE CONSTRUCTION OF CONTRACTION JOINTS
Reinforcement of new concrete doweled to old.

portals and long sections of coping. It is interesting to note that the first of the copings to be redone were cast in forms, but it was later found more expedient to "run" them with a templet, particularly for the curved sections which required expensive forming.

Work on the back of the wall consisted chiefly of waterproofing the rear of the structural cracks and the laitance line at the level of the coping. This was done by cutting out the concrete to a depth of 1½ in., filling with mastic and protecting by a strip of fabric wiped on with hot asphalt. This necessitated excavating a pit 3 ft. square and 9 ft. deep back of the wall at each of the cracks, and a ditch about 18 in. deep extending around the inside of the wall. It was originally intended to fill the pits with gravel, but the soil proved to be so porous, being principally a coarse bank sand, that special material was considered unnecessary.

Although the tunnels passing under the mass of fill, which had been waterproofed by the membrane method at the time of the original construction, had not leaked to any extent, serious cracks had opened between the portal entrances and the adjacent sections of the retaining wall. These were cut out and filled with elastic cement, after which the extrados of the tunnels immediately back of the portal entrance was graded and covered with a two-ply membrane, laid in hot asphalt and properly protected.

Regrading the Gutters—One of the most important features of the entire work was the regrading of the gutters which form a part of the top of the wall. The surfaces were ripped off by means of electric hammers to a depth varying from ½ in. to 2 in., after which the jagged concrete was thoroughly cleaned. The mortar used for regrading was composed of one part cement to two parts by volume of well-graded sand, with the addition of a waterproofing compound. As this work was most carefully done, it served as waterproofing for the portion of the wall occupied by the gutters.

After all cutting and patching had been finished, exposed surfaces of the wall received three coats of iron waterproofing. Two coats of decorative finish will be applied when the waterproofing has oxidized sufficiently to avoid rust spots showing through the surface.

From this description it is evident that the success of such repairs depends largely upon the care with which the work is done. It is particularly essential that patches of new material be applied only against thoroughly roughened surfaces and that they be kept moist for a sufficient period to avoid premature drying.

The work was done under the supervision of the writer, acting as consulting engineer for the Yale Athletic Association. The A. C. Horn Sales Corporation was the contractor, and its products were used in the work of reconditioning.

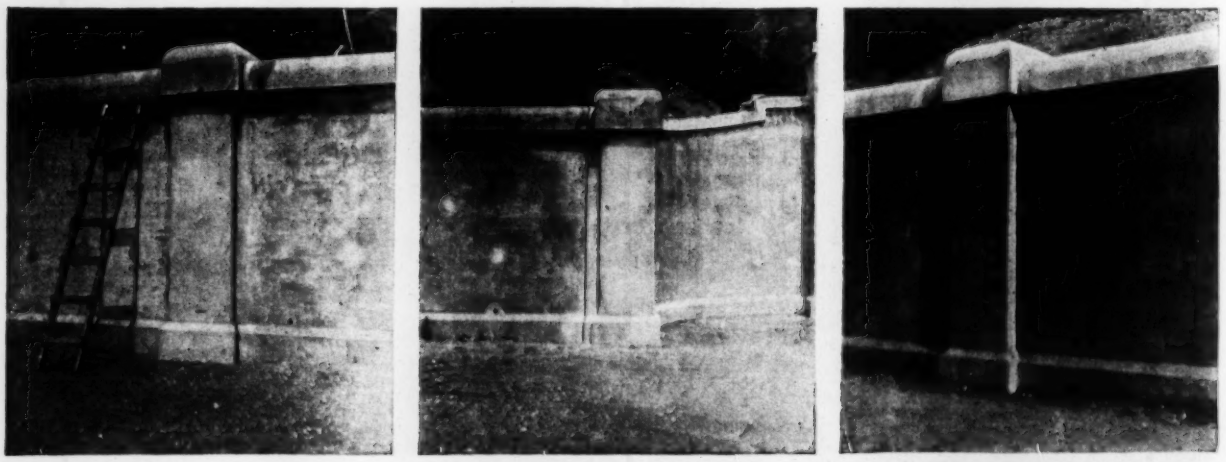


FIG. 5—COMPLETED CONTRACTION JOINTS
Two views at left before placing surface mastic; right-hand view, completed except for coloring mastic to match concrete.

Technical Divisions Prominent at Civil Engineers Meeting

Seven Divisions Hold Sessions—First Reports on Status and Progress of the Art Presented—Important Research Reports—J. Waldo Smith Made Honorary Member—Anson Marston Becomes President

RESEARCH committee reports and technical division activities monopolized the working program of the American Society of Civil Engineers at its annual meeting in New York City last week. The society as such had no papers or discussions other than the research reports. The technical divisions, however, displayed remarkable activity; no less than seven divisions were in session, in each instance with a strong program. Several of them also for the first time presented reports on the status and progress of the art, a feature initiated during the past year and intended to be a regular part of the work of the divisions each year.

Figures given by the board of direction in its annual report brought to light the remarkable growth of the Society in the last few years. The membership increased 20 per cent in three years, and during the past year had a net numerical increase of 820. The total membership now is 13,577, not counting some 5,000 students. Of this total 11,425 are corporate members, or 84 per cent of the membership.

An impressive event of the meeting was the conferring of honorary membership on J. Waldo Smith, longtime chief engineer and now consulting engineer of the Board of Water Supply of New York City. The venerable Clemens Herschel, himself an honorary member, spoke in happy vein of Mr. Smith's long and fruitful career in public service, to which Mr. Smith replied with characteristic terseness.

Associated with this ceremony was the formal presentation of medals and prizes to the authors of the best papers of the past year, as noted in our news pages last week: C. E. Sudler, R. B. Young, J. F. Case, R. G. Finch, and Franklin Hudson, Jr.

The three important research committee reports are briefly reviewed below, followed by brief remarks on the proceedings of the more active technical division sessions.

Research Results

Impact in Highway Bridges—A final report on highway bridge impact was rendered after six years' work by a committee under the chairmanship of Prof. A. H. Fuller, of Iowa State College. The report summarized anew the principal results of stress measurements on bridge floor and truss members under moving vehicle loads, reported some years ago, and then presented recommendations for impact values to be used in highway bridge design. These are: For floors and floor beam hangers, and for members of spans less than 40 ft., 25 per cent impact; for truss members of spans longer than 40 ft.,

$$I = \frac{50}{L + 160}$$

The committee also gave a table of the ratios of bridge floor impact to pavement impact under the same loads and the same roughness conditions. It also observed that other factors of bridge action, such an inequality of stress distribution in members and the effect of floor participation, make it desirable that before further impact studies are undertaken there should be a general investigation of stress phenomena in bridges, including secondaries.

Concrete Arch Tests—Working under the chairmanship of Prof. Clyde T. Morris, of Ohio State University, the committee on concrete arch research has heretofore studied a variety of subjects, including model tests of the elastic behavior of skew arches, stresses in full-sized concrete arch bridges, and the like. During the past year the principal work of note was the study of stresses and deformations of a number of 17½-ft. arch spans with rise of 4 ft., at the University of Illinois. This work is noted below as it was separately presented in the meeting of the Structural Division. Briefly, the results demonstrated very fully the elastic behavior of these arches, modified chiefly by variations in the character of the concrete at different points in the arch.

Tests on Steel Columns

Steel Column Research—In a report of more than 100 pages the committee on steel column research, headed by Prof. F. E. Turneaure, of the University of Wisconsin, gave in detail the results of extensive tests on solid-section, latticed and batten-plate columns carried out during the past three or four years at Wisconsin. Some of the results of this work have been made public previously.

The most important tests were made under eccentric load and under applications of load having opposite eccentricity at the two ends of the column so as to subject the columns to a known amount of shear. The different types of columns showed large differences in shearing rigidity, as was to be expected. The greater flexibility of the built columns in the direction of lacing or batten plates can be equalized by providing larger radius of gyration in this direction. Batten-plate columns were found to be weak under loadings that produce high shear; such loadings set up high stresses in the individual segments of the column. Lacing-bar strength is correctly indicated by direct compressive tests of single bars, but the stresses in lacing are often much greater than those resulting from shear calculations, the excess ranging from 1½ to 3 per cent of the load. The crookedness of columns was found to be not an important matter, but the obliquity of the column ends was of considerable effect. Unsupported plate width transverse to the column length, it was deduced from the Delaware River Bridge tests, may safely be carried as high as 40 times the thickness. Outstanding compression plates or flanges will be safe against buckling up to about 30,000 lb. per sq.in. provided the width is not greater than twenty times the thickness.

Further studies are planned to be made on (1) the strength and effectiveness of lacing, batten plates and diaphragms; effect of form of section, outstanding flanges, etc.; unsupported length of component parts; and other details; and (2) the conditions of the column as a part of a structure, its end conditions, crookedness and the effect of other members thereon.

Two papers of unusual importance, on arch investigations, occupied the attention of the structural division in its two sessions. In the one, Prof. Clyde T. Morris reported on the load tests made on the condemned Yadkin River bridge in North Carolina last year. In the other Prof. Wilbur M. Wilson, of the University of Illinois, set forth the results of his 17½-ft. model concrete arch experiments.

In a third paper Leon S. Moisseiff, advisory engineer of design of the Port of New York Authority, told of the thorough design studies, analytical as well as by model, carried out in connection with the 1,675-ft. Kill van Kull steel arch bridge now being built, the largest arch yet attempted by man. Not only the action of the main trusses, but also the relative stress and deformation effect of the lateral system and the sway bracing were investigated. The possible occurrence of hard spots in the span, such as might be found at the main portals, was studied, but the result was entirely reassuring.

Full-Scale Bridge Test

Yadkin River Bridge—Stress and distortion measurements under destructive loads were made last year on a five-year-old highway bridge across the Yadkin River in North Carolina, which had to be removed because of submergence by a new power dam. It comprises three arches of 145 ft. span and 20 ft. roadway, with deck slab carried on cross walls on the rib. Measurements were made both with deck intact and with deck and parapet walls cut across at several points to break the deck continuity. Load was applied by two wooden tanks which when filled with water weighed something over 300 tons each. With both tanks placed so as to produce maximum stresses, the arch rib was cracked at two points but did not collapse. The structure behaved throughout in accord with elastic arch calculations, based on the assumption of the concrete taking tension; the effective modulus of elasticity of the concrete was about 4,000,000 lb. per square inch; the piers, which rested on rock at river bed level, showed no perceptible deflection; and the stiffening influence of the deck before it was cut across agreed with that found by tests on a small sheet model.

Discussion brought out a number of interesting sidelights on the test results. Dean G. M. Braune, of the University of North Carolina, remarked that this test was the first full-sized verification of arch theory in more than 30 years, since the Austrian arch tests. He pointed out that since the deck would not participate in arch action under the dead load alone, its effect in reducing the rib stresses would require consideration only for live load and temperature change. Prof. Hardy Cross, of the University of Illinois, discussed among other things the temperature stresses, and showed that the rising of the arch as it expands would put much of the length of the deck into tension; therefore the deck participation would increase rather than diminish the temperature stresses. F. R. McMillan, director of research for the Portland Cement Association, called to mind that all deformations in reinforced concrete correspond to unbroken concrete on the tension side, a fact again confirmed by the Yadkin test. F. E. Schmitt, editor of *Engineering News-Record*, after referring to the investigation as a large-scale confirmation of the model results obtained by Professors Beggs and Wilson raised the question of how the findings would ultimately be used in practical design. While the deck participation increases the rigidity of the arch, there is a limit to the desirable degree of rigidity in arches. In so far as a spandrel-bracing effect is advantageous, the ordinary column-and-slab construction of the deck supplies it rather inefficiently, and new forms of arch structure may prove better adapted.

Illinois Arch Tests—Professor Wilson's tests of reinforced rib arches of 17½ ft. span and 4 ft. rise, which were carried out with remarkably complete and well devised equipment, were in part reported two years ago, but the present report covers much more extensive work. The earlier report dealt with the least width of rib required for effective resistance to lateral buckling; a ratio of span to width of 30 in one test and 39 in another was found to assure this resistance, showing no reduction of carrying capacity; ratios of 50 and 79 showed a large reduction of capacity.

The present report covered strength and deformation in load tests with and without deck; decks of different heights above arch columns were tested, and in some tests the deck was cut apart by expansion joints. Special deformation tests were carried out to determine the modulus of elasticity, and to check its determination from compression specimens. Variations in elastic behavior of the concrete in different parts of the arch were noted, and it was found that "the strength of an arch is determined by the strength of its weakest section, and failure to consolidate the concrete at a single section may be as serious as a partial omission of cement, as the use of poor aggregate or as the use of too much water. The arches in these tests were poured more carefully than many concrete structures, yet the variations in the modulus of elasticity and presumably in the strength were very great."

The broad showing of all the tests was that the arches behaved in precise accord with elastic analysis based on tension in concrete, both with and without deck, and that the deck participation tended to produce more critical stresses in the columns and slabs than in the ribs. The unit stress developed by the concrete in the arches was approximately equal to that developed by the same concrete in control cylinders. Expansion joints in the deck virtually eliminated the increase of arch strength produced by deck participation. The beautifully precise accord of test results with theory was shown best by a plotting of arch thrust on a base of load, which yielded a straight line almost exactly superimposed on a line plotted from theory.

Prof. George I. Beggs, of Princeton University, gave a full presentation of his deformeter study of sheet celluloid arch models with and without decks, in which the great effect of deck participation in reducing arch distortion and stress was brought out strikingly. Quite as would be expected, the tests showed that this effect is small under symmetrical loading but large under unsymmetrical loading. A. Burton Cohen, consulting engineer, told of the cracking of continuous deck slabs on the Paulins Kill viaduct and the Delaware River bridge of the Lackawanna Railroad, and the resulting adoption of expansion joints in the company's Tunkhannock viaduct.

Prof. Hardy Cross, of the University of Illinois, stated that variations in elastic modulus of the arch material should have little effect on the behavior of the arch. Arch analysis, he said, is virtually a problem in probabilities.

E. E. Howard, consulting engineer, remarked that deck participation exists for live loads only, but that its effect depends upon the placing of the load. The test results might have been different had the loads been applied on

the spans of the deck slabs instead of over the columns. The question of whether expansion joints may be omitted cannot be answered from the results of the Wilson tests.

Surveying and Mapping Division

Although the program of the Surveying and Mapping Division was marred by the inability of the authors of two scheduled papers to be present, lively discussion and impromptu talks made the meeting an interesting one. Several pointed out that engineers and contractors in general are apt to disregard the importance of correct and precise surveys on all work. One instance was cited where haphazard surveys in locating several piers of a bridge had resulted in grief and expense to the contractor. Col. C. H. Birdseye, of the U. S. Geological Survey, maintained that contractors are awakening to the need of precise surveys and are offering more cooperation than formerly to secure these results.

Others spoke on the need of research in new and improved methods in surveying. Most of the present-day practices were developed by the U. S. Coast and Geodetic Survey and the Geological Survey, it was declared. The lack of publicity accorded the subject of surveying and mapping was deplored. Publicity on a scale accorded other engineering subjects, it was held, would do much to impress the importance of surveying upon those concerned with its practice.

Robert Hoppen, Jr., resident engineer of The Port of New York Authority, read a paper on the location surveys for the four Port Authority bridges. Methods of laying out the base lines and the systems of triangulation used for each of the bridges was explained. Surveys for the Holland vehicular tunnel, New York, were explained by Charles L. Crandall, engineer of maintenance, Holland Tunnel. Difficulties of triangulating in the congested waterfront district of lower Manhattan and the methods of carrying the lines forward within the tunnel were told. A paper on the surveys of the Carquinez Straits bridge was presented by George J. Calder, vice-president, American Toll Bridge Company.

Power Division

The session of the Power Division was unusually well attended, there being well over 100 members present. No report of the Committee on "Ice as Affecting Power Plants" was presented, but the chairman, Francis C. Shenehon, had arranged for Prof. Howard T. Barnes, of McGill University, to describe his most recent studies in the elimination of ice from the intakes of power plants, and had asked William T. Walker, construction engineer of the Northern States Power Company, Minneapolis, to present a discussion of his company's experience in eliminating ice from the intake of steam power plants.

The experiments which Professor Barnes is now carrying on are quite different from his well known studies in the use of thermit. They have to do with the power of light rays to break down ice crystals, and while still in their early stages—this being the first instance in which Professor Barnes has discussed the subject publicly—the results are very encouraging. After exhaustive laboratory studies on the formation of ice crystals and of the effect of light upon such crystals, Professor Barnes began experiments with a specially constructed light unit which he submerged in the intake of a hydro-electric plant in order to get the benefit of the mechanical transmission of heat from the light unit to the water as well as the heating effect of the light rays. It was found, however, that the light unit submerged in the flowing stream produced objectionable vortexes. As a result, the tests are now being carried on with light units suspended under reflectors directly over the intake. Three 1,500-watt lamps are being used in the present experiments at an intake in the St. Lawrence River. With this arrangement it has been found that frazil ice collects upon those parts of the bars of a metal screen at the bottom of the channel which are protected from the rays of the light, while none forms on the parts exposed to the light.

Mr. Walker's paper described how, by chance, it was discovered at a steam plant of the Northern States Power Company that frazil ice could be eliminated from the cooling water by recirculating part of the water coming from the condensers at times when the cooling water temperature was low enough to cause ice crystals to form. The discovery came about due to the accidental deflection of discharge cooling water into the channel approaching the water intake.

The "pumped storage" plant of the Connecticut Light and Power Company on the Rocky River was described by Joel D. Justin, Hydraulic Engineer, U.G.I., Philadelphia. In this plant water from the Housatonic River is pumped into a large storage reservoir to be returned to the river at times of peak load or low flow. Mr. Justin's paper went into the theory upon which such plants are built, as well as into the details of the plant itself. The construction of such plants, he stated, is justified as offsetting old steam plants or postponing the construction of new ones, and also by their value as regulating reservoirs to increase the firm power of plants down stream.

George A. Orrok, in discussion of the paper, stated that such plants in theory could be used at many locations in this country, but that real estate and water rights costs made most of them too expensive. W. W. K. Freeman of the New England Power Company, in an illustrated discussion of Mr. Justin's paper, described most of the storage plants in Europe, and outlined their peculiar characteristics. Other discussions brought out the importance of detailed study of stream flow data in estimating the usefulness of such plants. E. A. Van Deusen, Poughkeepsie, pointed out that the increased efficiency of modern pumps made pumped storage even more attractive now than when some of the older European plants were built. On this subject, W. M. White, Milwaukee, stated that the three-part units used in some of the older European plants were built before present-day high efficiency pumps had been perfected, and that the high speed of such pumps made the use of generators as motors out of the question.

Construction Division

Practical progress on developing, assembling and organizing literature on construction plant and methods was the outstanding feature of the report of W. J. Barney, chairman of the executive committee of the Construction Division at its afternoon session, Jan. 17. During the year committees on road building, hydro-electric work (power installations), concrete buildings, steel buildings, and concrete bridges were appointed.

It is the purpose of these committees to study and report on the general problems of construction plant and methods and prepare reports which will ultimately embody data and information to serve as a basis for a handbook to guide the engineer in the selection of the best methods and plants to use. Reports are to be published from time to time in one of the society's publications so that they will be in use prior to the time it is possible to complete an edition of a handbook.

The Division has also compiled a bibliography of books and leading magazine articles published over the past 10 years on the general subject of construction plant and methods which contains some 700 references and is cross-indexed by subject matter and author. This will probably be available in final shape in the near future.

The committees on road building and concrete bridges reported with comprehensive outlines on what their studies would include and the basis on which the final report would probably be made. The committee on hydro-electric work made a detailed report on progress schedule, water control including cofferdam, and construction plant. The latter included camp requirements, power supply, transportation, excavation, concrete plant, location of mixing plant, capacity of plant, mixing plant accessories, concrete placing equipment, power station building, and machinery installation. The preliminary report of the committee on plant construction and methods for concrete buildings was accompanied by a comprehensive report on the use of central-mixed concrete for buildings. The report on construction methods and plant for steel building outlined advantages of derrick types, detailed methods of raising and lowering guy derrick, sizes, location and importance of guy wires and methods of handling steel. Planking, signaling systems, personnel, hoisting towers and equipment, scaffolds and motors and their uses are described.

Construction of the James River Bridge Project, a paper under joint authorship of R. C. Wilson, vice-president, Turner Construction Company, Chicago, and Herbert B. Pope, superintendent of construction, Turner Construction Company, Newport News, Va., was presented, with the aid of slides, by the latter. Since this subject was covered by *Engineering News-Record*, Jan. 10, this paper will not be reviewed here.

Highway Division

Traffic problems and responsibility of the highway engineer to the public brought out a lively discussion in the Highway Division meeting of regional planning and its relation to traffic, political handicaps contributing to instability in highway organizations and the equitable distribution of money obtained from highway taxes between state, local units and municipalities.

Leslie G. Holleran, deputy chief engineer, Westchester County Park Commission, opened the session with an address on "Problems of Traffic Regulation and Control" by stating his belief that too many people hold to the idea that the beginning and end of traffic control is in the adoption of traffic ordinances, squads of policemen and the installation of traffic lights. He named three stages of traffic relief work. (1) Revising street systems; (2) palliatives or remedies that do not entirely cure; and (3) police, traffic lights and ordinances.

E. W. James, chief, Division of design, U. S. Bureau of Public Roads, Washington, D. C., opened the discussion by emphasizing what Mr. Holleran had stated, and by defining the highway designer's interest in traffic as his responsibility to plan highways for 100 per cent efficient use. Mr. James made the obvious comment that congestion occurs where traffic has to stop, not where it can keep moving and showed the effect of too frequent intersections.

Regional planning is needed to insure that worse future conditions may be avoided. Remedies listed included: reduced number of intersections; rectangular intersections, which are better than acute angular intersections; and rotary intersections, designed to take care of relative conditions of traffic and radii. Of the latter the ultimate efficiency is not known and Mr. James stressed the importance of research to determine what rotary intersections can contribute to traffic relief and for what kind of traffic they are best suited.

Mr. James showed how present traffic conditions would be aggravated by future improvement of present plans for undeveloped local highways or roads on the gridiron system now laid out. He proposed systems of rural planning which would reduce the total length of rural roads to be built and maintained in the future and hold them for purely local use.

The discussion of turning islands opened by Prof. J. F. Crandall of the University of Illinois was answered by Mr. James who stated that radii were now used ranging from 20 ft. in Richmond, Va., to about 143 ft. in DuPont Circle, Washington. The value of the island depends upon its radius and the distance between spokes which must be sufficient to permit inter-weaving of cars. He expressed his belief that the capacity was a function of the radius and that the width of the drive should be approximately 25 per cent of that of all radiating streets. These figures he described as working figures which he would like to check through actual research.

A. R. Hirst in defining Responsibility of the Highway Engineer to the Public, stated that methods of apportioning the funds for highway improvements so that cities which contribute a large proportion of the imposts may participate in the use of funds for city streets need greater study. Unstable conditions due to too much political interference with highway organizations were outlined as fields in which the engineer can better serve the public. Without problems of finance and political interference the strictly engineering phases of highway work are not especially troublesome. Responsibility to contractors, including early-payment clauses in contracts, rather than "endowment at age of 85 policies" will bring in a better class of contractor and serve to cheapen public work, Mr. Hirst stated. Adequate and efficient, honest inspection is needed to insure that competent engineering design is constructed as planned. This is one field where political intervention exists and where it is the engineer's duty to stamp it out.

William H. Connell, consulting engineer in Philadelphia, opened the discussion of Mr. Hirst's paper by stating that with the American system of government, engineers were bound to have too much interference with public work. The field could not be made up of leaders and that lieutenants serve a very important function in the industry. He did agree that on some highway work the public was not getting 50c. on the dollar in its highways. In spite of the fact that there were good engineers at the top, there was not sufficient inspection. He believes that highways should be entirely supported by motor vehicle taxes and that all funds should go to rural districts until this system of highways is completed.

In the discussion of apportioning part of highway tax money to cities for street improvements, C. E. Myers, director, Department of City Transit, Philadelphia, asserted his belief that it was better for these funds to go into state highways and for city funds to be appropriated separately. Outside funds available for city highways might encourage the city administration to transfer funds, in greater amounts than the new funds available, away from highways into something else. He suggested that state aid to cities on a system of controlled streets similar to the federal aid to states might be a solution of this problem.

City Planning Division

Of two topics before the City Planning Division the first was "The Relation of the Lawyer to the Other Professions Engaged in City Planning," presented by Alfred Bettman, a Cincinnati attorney, for a long time prominent in city planning work. In summary, Mr. Bettman stated that the science of city planning comes first and the law second. The other topic was the "Westchester County Planning and Park System," presented by Jay Downer, chief engineer. Before describing the park system and the work of the commission Mr. Downer stated as a conclusion from his experience and observation that city planning, well carried out, is largely self sustaining, and that it can be effected if wastefulness and graft under bad political conditions can be eliminated.

Sanitary Engineering Division

The activated-sludge plant of the City of Milwaukee, including also a review of the work of the city and the metropolitan sewerage commissions since their creation, was the leading feature of the one session of the Sanitary Engineering Division. Darwin W. Townsend, assistant to W. N. Cramer, chief engineer of the commission, led off and was to have been followed by six speakers, most of whom were unable to be present. The activated-sludge plant treated an average of 85 m.g.d. in 1928, removing 95 per cent of both the suspended solids and the bacteria. Operating and maintenance expenses for the year were $900,000. Milorganite, the trade name for the fertilizer recovered from the sludge, yielded $600,000. No mention was made of capital charges upon the investment in the plant.

In discussion, W. R. Copeland, formerly chemist of the commission, spoke of the promise of utilizing the heat of fermentation as an aid to sludge digestion, thus greatly reducing its digestion period. T. Chalkley Hatton, until recently chief engineer of the commission, said research work promises to make possible a material reduction in Milwaukee operating costs, down to $15 per m.g., compared with $35 to $70 at some other [and much smaller?] activated-sludge plants. He thought the process just named could not be considered a success unless the sludge is reclaimed, but this may be impracticable at small plants. In a written discussion by Langdon Pearse, sanitary engineer, the Sanitary District of Chicago, read by S. W. Greeley, Mr. Pearse stated that it was difficult for him to share Mr. Townsend's enthusiasm for sludge processing—which is not attempted at the large North Side plant put in operation late last year by the Sanitary District of Chicago.

The work of the New Jersey sewage research station, New Brunswick, N. J., under the direction of Dr. Willem Rudolfs, was the subject of a report of a committee of the sanitary engineering division, Am. Soc. C. E., read by W. R. Copeland. Stress was laid on the progress of sludge digestion and of the control of odor from sprinkling filters.

The final topic on the division program, "Is Public Health Engineer a Better Title than Sanitary Engineer?" introduced by Prof. C. M. Spofford, Massachusetts Institute of Technology, and discussed further by Abel Wolman, Chester G. Wigley, Thorndike Saville, and others, seemed to show a concensus of opinion for confining undergraduate college work and degrees to civil engineering, leaving specialization for graduate work, and also a preference for the sanitary engineer rather than public health engineer when either is used.

Unique Fire House Structure Made of Precast Units

By Frank Colbourn
Commissioner of Public Works, Oakland, Calif.

THE PROBLEM of building an attractive fire house on a side hill in such a way as to improve the surrounding property and give the maximum of efficiency to the apparatus and of comfort to the men has been solved in Oakland, Calif., by the structure shown in Fig. 2. The apparatus room is at street level, while dormitory and living quarters for a double company are placed in the building on the high end of the lot approached by a flight of steps following the contour of the land.

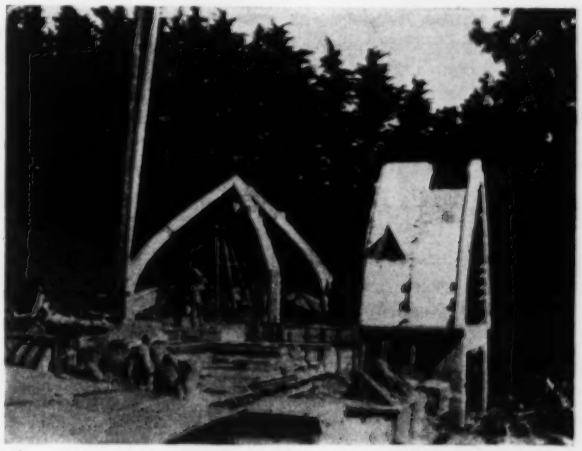


FIG. 1—CONSTRUCTING A FIRE HOUSE OF PRECAST UNIT
Reinforced-concrete roof framing at left. Some of roof slabs in place at right.

The building is unique in that certain new types of building construction were utilized. The complete building is made of precast units, these including a reinforced frame and precast sides and roof lined with a special wallboard cast with the slabs. The roof was painted with waterproof plastic asbestos cement direct on the concrete. The building is equipped with a 30-ft. high hose-drying tower. The contract price with extras was $18,900. Grading, painting, paving and furnishings brought the total cost to $22,826.

FIG. 2—FIRE HOUSE IN OAKLAND, CALIF., BUILT OF PRECAST UNITS

Mississippi River Flood Control

II—Levee Construction Methods and Plant

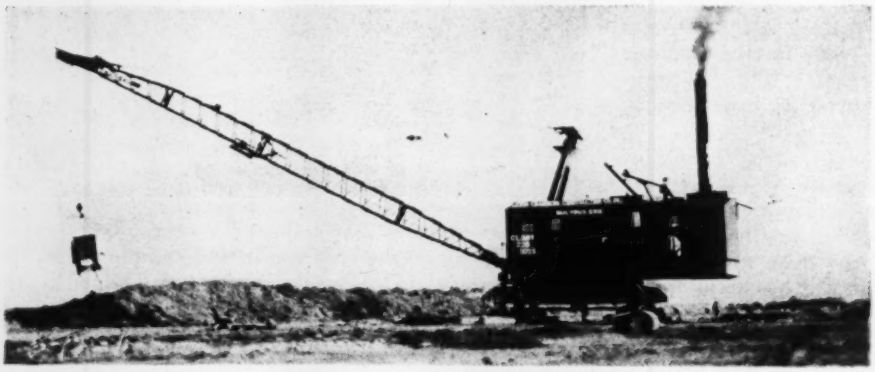
Long Haul From Borrow Controls Methods—Wagon Outfits Still Have a Place—Tower Machines and Draglines Excel in Levee Placement—Hydraulic Dredge Pumping for Machine Placement Gives Great Promise—Possibilities of Hydraulic Fill

By C. S. Hill
Associate Editor, Engineering News-Record

With the sources of levee borrow material farther removed, as described in the preceding article, the operations of digging, carrying and placing are separated. The one-unit plant, with exception of the hydraulic dredge, is eliminated. A two- or three-unit plant has to be substituted. It is along this line that experiment has been made this fiscal year and that research must be intensified in the coming year.

Tractors and Teams

Make note positively of the fact that the old earth-moving outfits—mules and wheel scrapers and mules and dump wagons loaded by elevating graders—are not obsolete. They are small-yardage tools, but there will be, with the big work, many small-yardage and individual operations for which they are excellent tools. Many of them have been busy this year and will be demanded in succeeding years' levee work as odd-job builders under subcontracts. Virtually they have ceased to have position as principals in levee contracting.



LARGE DRAGLINE FOR LEVEE CONSTRUCTION
This machine has a 6-yd. bucket, 150-ft. working radius and 200-hp. boiler. It travels on parallel standard-gage tracks 30 ft. apart and moves from job to job on river barges.

In advance and in a little better competitive position for independent operation are the dump-truck and light-tractor outfits with elevating grader, light power shovel or dragline excavating and loading units. These again classify as odd-job subcontracting outfits, but, if well managed, with a capacity for bigger operations. Incidentally the experience has been that a more sturdy light tractor is needed and that operators must get away from the old mule-power idea of one-shift operation. The value of light tractors in dump-wagon hauling lies in working them to capacity.

This truth applies still more strongly to the heavy tractors and large-body trailers on caterpillars. As being tried out this year an operating unit comprises a tractor and a 4- or 7-yd. trailer. From observation in the field the following conclusions were set down as reasonably assured. Generally speaking, the 4-yd. trailer is the more economic. It is faster, can be handled on softer ground and is heavier and sturdier in proportion to its load capacity. In general neither the tractors nor the trailers which have been used are strong and durable enough. There is little smooth hauling in levee work and there are steep grades. The trailers, too, need more strength to stand up under the shock of loading by dragline or shovel. In mud the crawlers ball up and the machines stall; silt produces a soft mud, and buckshot clay a sticky mud beyond comparison. The material is hard on crawlers, and crawler replacement is a frequent and heavy expense. To date trailer crawlers have been of rather crude design and workmanship. The compaction of embankment under the travel of the crawlers is excellent.

There is, then, in tractor and trailer equipment a task for manufacturers in designing and building stronger machines. Contractors have also the problem of devising means much more effective than are now provided to meet mud conditions. The present caterpillar tread areas and mechanism are not meeting mud conditions in silt and buckshot. The contractor has the task of getting more out of his machines. In shifting over from team hauling the contractors too often have brought over their mule-team habits. They are frequently working only one shift a day, which was a quite proper procedure perhaps when the hauling units as well as the workmen had to rest up, but is quite an uneconomical procedure when hauling units are tractors and require only a regular shift of men to work continuously. The profit in heavy tractor and trailer operation lies in working double shifts.

Tower Machines and Draglines

While the "wagon outfit," whether mule-hauled or tractor-hauled, will have its place in levee work, the big job is for larger-unit equipment. With ample borrow in reach the tower machine and the dragline excavator have proved themselves *par excellence* the cheapest levee-building devices working on land. The natural result has been to turn attention under the new conditions to continuing in service these excellent embankment builders by devising methods of cheap carriage of material to them. All the year's methods of levee building, except direct hydraulic-fill work, are developed on this general idea. They are building railways and pumping by hydraulic dredge.

Chiefly promise seems to lie in dredge pumping. This may be employed (1) to fill old borrowpits, which will then be re-excavated by tower machine or dragline handling directly into enlargement; (2) to make a wide hydraulic-fill base as high as practicable and then top off by machine-pulling the material from the edge of the extra-wide base. Perhaps the first true levee operation using pumped material was in 1927 in closing Mound Landing crevasse. (*Engineering News-Record*, Dec. 1, 1927, p. 870.) Dredge fill had been previously used, however, to fill crevasses and blue holes, refill borrowpits and build across-bayou dikes.

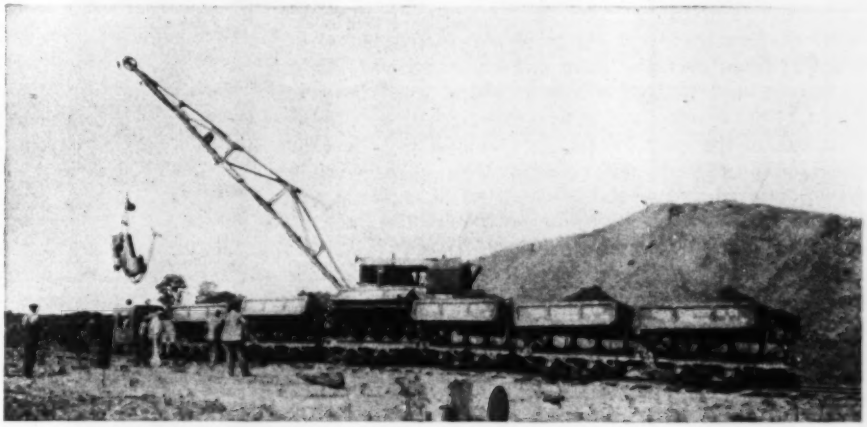
In this year's work three dredging operations have gone ahead. One is at Mound, where last year's emergency levee is being enlarged by pumping to the old-borrowpit and rehandling from pit to levee by tower machines. The other two are setback levee operations where the dredges are pumping directly into fill and draglines are topping out. In general, from the dredge fill operations certain broad conclusions can be reached.

The levee-building materials along both the main river and branches are sand, silt and buckshot clay and their combinations. Generally dredge fill will be either sand or silt from artificial dredge sumps or bayou bottoms. Of the two sand is a better material to pump and a better material in levee. The buckshot gives the usual trouble of clay in balling up in or plugging the pipe line. The silt works up into a soup which is slow to build up a fill and hard to drain.

To carry out a considerable dredging program there will have to be a rather well-developed program of borings to discover the best sources of suitable materials. On the Mound crevasse work and for some other operations the government engineers now have borings in progress. It seems logical as dredging work develops that locations of suitable material determined by borings must be a part of the information furnished bidders.

As to length and size of pipe line the ordinary dredging hydraulics govern. There will be locations where long discharge lines will be necessary and also many places where with a little channel digging from the river into the work a short discharge can be had. This is particularly an opportunity for the smaller sizes (10 to 15 in.) of dredges. These machines this year have done some encouraging pioneer work.

The dredging lifts on the Mississippi work are in general moderate, particularly where the pumping is to refill old borrowpits. Where levee embankment is built up by hydraulic fill, the lifts naturally will be greater. The lift, too, varies with the stages of the river. In closing Mound crevasse the lift due to water stage varied from 0 to 35 ft.



TRAIN HAULING FOR DRAGLINE PLACEMENT
The train operates from a borrowpit 600 to 900 ft. away and dumps into a trench dug just ahead of the embankment. The dragline excavates from the trench into the fill.

Water-stage variation, then, is a factor which the dredging contractor will have to keep in mind. High stages cut down the lift, but on the other hand increase the length of ladder.

Probably the biggest problem of the dredge operator will be draining of the fill. This will be particularly the problem in pumping into old borrowpits for rehandling into levee. The fill must dry out well before it is fit to rehandle, and none of the commonly available materials loses water fast. This is especially the case when the fill is in pits without free drainage. There it may take months to get the material dry enough to be best handled by buckets; and in addition to handling there are the problems of shrinkage and of holding the material to slope in the embankment. It will require careful provision for drainage where old pits are filled hydraulically for rehandling. It is possible here that a system may be worked out whereby the pit filling can be contracted far enough ahead of levee building to permit the fill to drain and compact.

TRACTOR AND 7-YD. TRAILER ON CRAWLERS
An unusually perfect load. Haul about 600 ft. This is an example of the best kind of material for elevating-grader loading as shown in another view.

Hydraulic Fill

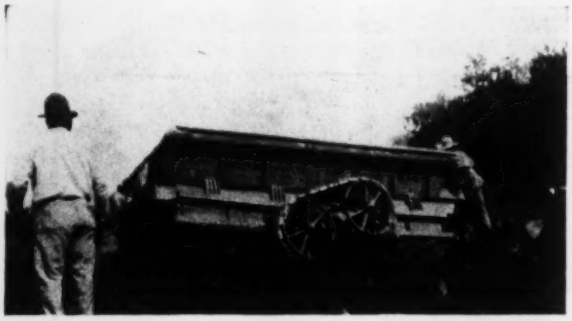
Direct hydraulic fill into levee embankment presents a difficult problem of holding the fill to the slopes of standard cross-section. Running

free, the material takes slopes of 1 on 25 to 1 on 125. The use of confining dikes, flashboards, shutter-pipe discharge and all the other devices for restraining hydraulic fill will be required. They can be and have been worked out pretty efficiently for base fill and fill up to part height where the pond becomes narrow. A plan worked out this year which seems to promise to meet the situation is to build up part height with pumped fill having enough extra width to furnish material for dragline topping.

Conclusions on Dredging

In all, the hydraulic dredge seems to offer inducements as a levee enlargement tool which make it a leading candidate for experimentation. A procedure will have to be worked out to overcome some obstacles peculiar to the conditions of levee construction, but these obstacles appear far from insurmountable when looked at from even the most unfavorable side. There will also be opportunity for both large and small dredges. Indeed, the development of small-dredge operations seems one of the most interesting possibilities. Type of dredge offers no particularly new problem. Cutter heads will be required and reasonably high power. There will be some possibilities, in working old banks and bars, of buried logs and stumps with their hazard to cutter heads. In the dredge work so far the trouble has been insignificant, but there may be an opportunity for invention here.

Mention has been made of surveys for selected material for hydraulic fill for levee construction. It would seem that this was one of the most worth-while developments to be undertaken. With the ability of the dredge to go farther afield for its material, some degree of material selection would seem practicable and worth seeking. In fact, in all enlargement work when the builder must go outside the old pits for material it would seem that selection could well be considered more than it has been in the past. It has to be recognized, however, that the



AN EXAMPLE OF ROUGH GOING AT THE DUMP

The trailers seldom "bog down" to an extent that the tractors can not pull them out, though after a rain the tractors occasionally dig themselves in so badly that they have to disconnect from the load, get out on better footing and then pull the load by means of a cable. Even with slippery condition of ground following heavy rain the tractor is usually able to get out of trouble alone.

range of selection is not very wide and that a levee is an impounding dam only for short periods.

Railway Haul

In railway haul for dragline placement a different set of conditions prevails. There is but one operation in this year's work from which to draw conclusions, but it indicates several things rather clearly. Contrary to hydraulic dredge fill for rehandling, where large stores ahead are required, railway haul, at least as employed on the operation indicated, provides stock for the dragline only about as fast as it is taken away and deposited in the embankment. The loading unit, the hauling unit and the placing unit have to be closely co-ordinated and synchronized to get full efficiency. The equipment and procedure, however, are simple and familiar; the dirt requires no preparation to go into the fill; and it can be so closely placed for rehandling that only small draglines are needed. In the operation this year the haul was short, only 600 to 1,000 ft., so that it gives small indication of economic haul. Further description of and comment on the method will appear in a future issue, and discussion may be concluded here with the statement that it gives promise and encourages further trial. Except in one operation at Cairo, Ill., where the conditions are unique, there is no example on the river of dump-train-fill levee construction.

ELEVATING GRADER LOADING TRACTOR-HAULED TRAILERS

This view is on a contract operation near Whitehall, Ark. Note the smooth and fine character of the material being dug: almost perfect elevating-grader conditions.

Conclusions on Levee Methods

To date nothing has been offered in the way of meeting the longer haul requirements of the new levee work beyond the hydraulic dredge and the railway. In placing equipment no advance has been made on the proved tower machine and dragline. The year's experience, too, has not developed any improvement in or extension of their use. For embankment where it can raise and place material within its working radius of, say, 150 ft., the dragline has no equal in economy. The tower machine is an even better levee builder, and where the reach for material is beyond the dragline limit up to 600 ft. it is a close runner-up to the dragline in economy. The year's experience and observation seems to have pretty well dissipated the notion that either device could be enlarged to extend its economical reach for embankment material. Both machines in their latest forms have been materially improved over those previously used, chiefly by crawler traction mounting and self-propulsion.

Now, while the contractor coming new into levee work is on somewhat an equal basis of experience with the old levee builder in solving the problem of going greater distances for borrow, he is in no such excellent position in placement work with tower machines and draglines. They are costly outfits. They have hard, heavy work and their ills of upkeep, repairs and breakdowns are of corresponding magnitude. A technique of operation and a knowledge of efficiency requirements have been developed and a practice has been perfected which require very close management to equal. The government, too, is in better position to compete in tower machine and dragline work. It has for some years been the chief operator of these

types of machines and has a force of operators, foremen and inspectors who are particularly skilled and have developed an excellent procedure. The government operators also have repair facilities which the contractor cannot profitably provide.

The large problem coming from the introduction of haul as a major element of the new levee work is emphasized co-ordination. The introduction of the two- and three-function plant—separate digging, hauling and placing units—introduces equipment-train management in

A MODERN MULE-TEAM UNIT ON 1928 LEVEE WORK
One-yard bottom-dump wagons, drawn by four mules hitched abreast, work in conjunction with tractor-drawn trailers. Note that only the larger "sugar mules" are in use. The small "cotton mules" passed with the passing of the slip scraper.

place of equipment-unit management. With the plant train, too, with its added investment, there is demand for more continuous operation. Day shifts alone, as employed by the old mule-team outfits, do not satisfy the economics of operation. Indeed, one-shift-a-day operation does not satisfy the economics of any of the new machine-outfitted operations.

Multi shifts call for lighting, and this with a train of equipment becomes a considerable undertaking as compared with lighting the work of a single dragline or tower machine. Lighting, too, must be job-produced in most cases. Power lines are available for economical tapping only in certain locations. Job plants of diesel engine-generator units are the installations that have been found most satisfactory, but there are opportunities for any of the modern night-work lighted methods.

(The third article, next week, describes plant for and methods of revetment construction with a study of contracting possibilities in this class of river work. Contraction works and the Bonnet Carré spillway are also described.)

Water Consumption in English and Scotch Cities 19 to 98 Gal.

DOMESTIC water consumption in 31 cities of England and Scotland ranges from 19 to 98 U.S. gal., with all but one of the fourteen Scotch cities being higher than seventeen English cities. The figures here given in tabular form are taken from a paper by John Bowman, chief assistant engineer, Edinburgh water-works, read before the British Institution of Water Engineers on Dec. 7 and abstracted at length in the London *Surveyor* on Dec. 14, 1928. Nothing is said as to total per capita consumption, including water used for trade purposes.

Mr. Bowman's remarks on factors influencing water consumption in England and why the per capita average there is less than in Scotland will interest American readers:

A house supplied from a well or outside tap from which water has to be carried will be contented with an average of two pailfuls per person, or about 4 (5) gal. per head per day. In addition, water is required for the weekly family washing, which is estimated at about 15 (18) gal. per head, which averages about 2 (2.5) gal. per head daily, so that the lowest possible average daily quantity of water required may be stated at 6 (7) gal. per head per day. [The figures in parentheses are U. S. gallons.]

When water is introduced to a single tap in a house it is probable that the average daily consumption will be about 6 to 8 (7 to 9) gal. per head per day.

The addition of a water closet at once increases the consumption per head. A 2 (2.5)-gal. flush cistern will consume not less than 4 (5) gal. per head per day and may rise to 8 (9.5) gal. per head per day. The consumption per head per day for houses fitted with cold water closets may range from 10 to 16 (12 to 19).

The installation of a bath further increases the consumption per head. The contents of a bath may be anything from 28 to 60 (33.5 to 72) gal. of water. If a weekly bath be taken by each inmate, this means an additional average daily quantity of from 5 to 10 gal. (6 to 12) per head, so that the daily quantity of water per head in houses with baths, water closets and tubs and sinks with a weekly bath for each inmate may range from 14 to 24 (17 to 29) gal. per head per day.

In a house containing four inhabitants where one takes a daily bath of 35 (42) gal. and the remainder a weekly bath, an additional 8 (10) gal. per head per day is required. The average daily quantity per head per day in a house under these conditions may range from 22 to 32 (26 to 38) gal.

Apart from waste of water, there is reason to believe that the water required per head will steadily increase at a greater ratio in the future than it has done in the past. The problem of providing the increased water supply is a serious one, more serious, in the author's opinion, in England than in Scotland. The reason for the higher consumption per head in Scotland as compared with England would appear to be due to a different system of sanitation. In Scottish towns earth closets and privies have been nonexistent for many years, whereas in England there are a great many houses where this system still prevails. Both systems are to a large extent the result of geographical factors. The large towns in Scotland have all grown up adjoining the sea, which at once provides an outlet for a water-borne system of drainage. In England, on the other hand, many large towns have sprung up far inland where the difficulties of sewage disposal have restricted the development of the water-borne system of drainage and consequently the consumption of water. It seems reasonable to assume that as time goes on the whole of the sewage disposal in England will be water borne and when this is brought about the consumption of water will be greatly increased.

A great deal of the recorded consumption in every town is due to waste. Where there is an abundant supply of water the elimination of waste is not so important, but where the supply is limited or as the demand increases, the question of the elimination of all waste becomes one which has to be seriously considered.

PER CAPITA WATER DOMESTIC CONSUMPTION IN ENGLISH AND SCOTCH CITIES

The basic figures were taken by Mr. Bowman from the British Water-works Year Book for 1928. The U. S. equivalents for British gallons have been added by *Engineering News-Record*.

England	Imp. Gallons	U. S.	Scotland	Imp. Gallons	U. S.
Sunderland	15.51	19	Aberdeen	32.9	39
Wolverhampton	17.00	18	East Lothian	34.9	41
Nottingham	18.18	22	Dundee	36.0	43
Sheffield	18.44	22	Elgin County	37.0	44
Birmingham	18.67	22	Edinburgh	37.0	44
South Staffordshire	19.30	23	Glasgow	37.0	44
Newcastle	19.64	23	Sterlingshire and Falkirk	37.8	45
Birkenhead	20.39	24	Peebles	40.0	48
Manchester	21.18	25	Stirling	42.8	50
Swansea	22.82	27	Lochgelly	44.4	53
Liverpool	24.70	30	Grangemouth	48.0	58
Leeds	24.72	30	Paisley	49.0	59
Portsmouth	24.77	30	Irvine and district	57.6	69
London	26.32	32	Helensburgh	81.7	98
Torquay	28.6	34			
Preston	32.0	38			
Plymouth	33.24	39			

Chicago Sanitary District Must Stop Diversion of Lake Michigan for Sewage Disposal

United States Supreme Court Declares Diversion Except for Navigation Illegal and in Defiance of Federal Government and Refers Terms of Decree to Charles E. Hughes as Master

DIVERSION of the waters of Lake Michigan to the Chicago Drainage Canal for purposes of sewage disposal is held unlawful by the United States Supreme Court in a decision rendered Jan. 14 on complaint of injury to navigation and riparian rights brought by all the States of the Union bordering on the Great Lakes except Illinois and Indiana, as noted in our news section last week. States in the Mississippi River Basin that joined Illinois and the Sanitary District in defending the suit have their claims for continuance of the diversion in the interests of navigation denied. The decision requires the Sanitary District of Chicago "to devise proper methods for providing sufficient money and to construct and put in operation with all reasonable expedition adequate plants for the disposition of the sewage through other means than the lake diversion." Right to divert a small amount of water from Lake Michigan for the benefit of navigation is admitted, but the Supreme Court holds that the quantity will be "negligible" as compared with the 8,500 sec.-ft. now being diverted through a temporary and revocable permit granted by the Secretary of War. Continuance of diversion under this permit was held justifiable only because that through the defiance of the National Government by the Sanitary District and the slowness of the Chicago District Court in handing down a decision in the suit of the government to cause the restriction of the diversion to the 4,167 sec.-ft. allowed under the early permit of the Secretary of War, a pollution of the Port of Chicago was created that was damaging to navigation and therefore warranted diversion at the rate of 8,500 sec.-ft., as authorized by a new permit of the Secretary of War granted in 1925, until sewage-works can be completed that will cut the necessary diversion to a minimum.

Hughes Recommendations Not Followed

Although apparently upholding all the findings of fact reported late in 1927 by Charles E. Hughes, to whom as master the matter was referred by the Supreme Court, and although supporting also some of the master's findings of law, the Supreme Court does not adopt Mr. Hughes' recommendations for the dismissal of the suit brought by the complaining states. Among the findings of fact that the Supreme Court upholds is that Lakes Michigan and Huron are lowered some 6 in. by the 8,500 sec.-ft. diversion and Lakes Erie and Ontario some 5 in., thereby materially reducing the tonnage that could otherwise be carried by boats engaged in commerce on the Great Lakes. For an extended abstract of Mr. Hughes' report, see *Engineering News-Record*, Dec. 1, 1927, p. 890. The Hughes' findings of law in support of claims made by the defendants on constitutional ground are not all passed upon by the Supreme Court—in fact none of them very directly—in the decision handed down on Jan. 14, which rests less upon constitutional grounds than upon the exercise of executive and administrative powers by the Secretary of War under delegation to him by Congress.

According to the decision, "The exact issue is whether the State of Illinois and the Sanitary District of Chicago by diverting 8,500 cubic feet per second from the waters of Lake Michigan have so injured the riparian and other rights of the complainant states bordering the Great Lakes and connecting streams by lowering their levels as to justify an injunction to stop this diversion and thus restore the normal levels." The opinion next notes a claim by the defendants that the "diversion is the result of Congressional action in the regulation of interstate commerce" and "that the injury, if any, resulting is *damnum absque injuria* to the complaining states." Against this the complaining states raise three constitutional points thus stated in the decision:

> (1) That the regulation of interstate commerce under the constitution does not authorize the transfer by congress of any of the navigable capacity of the Great Lakes system of waters to the Mississippi Basin, that is from one great watershed to another; (2) that the transfer is contrary to the provision of the constitution forbidding the preference of ports of one state over those of another; (3) that the injuries to the complainant states deprive them and their citizens and property owners of property without due process of law and of the natural advantages of their position, contrary to their sovereign rights as members of the Union.

Decision on any one of these claims, the opinion states, "in favor of the complaining states" would end "the case in their favor" whereupon "the diversion must be enjoined." Except for a paragraph introduced in passing (noted a few lines further on), the court does not rule on any of these three constitutional points, but introduces a lengthy discussion involving practically all the rest of the decision by saying: "But in the view which we take respecting what actually has been done by Congress, some of these objections need not be considered or passed upon." The paragraph in the decision that seems to bear on one of these constitutional points is as follows:

> It is further argued by complainants that while the power of Congress extends to the protection and improvement of navigation, it does not extend to its destruction or to the creation of obstructions to navigable capacity. This Court has said that while Congress in the exercise of its power may adopt any means having some positive relation to the control of navigation and not otherwise inconsistent with the Constitution, *United States* v. *Chandler-Dunbar Co.*, 229 U. S. 53, 62, it may not arbitrarily destroy or impair the rights of riparian owners by legislation which has no real or substantial relation to the control of navigation or appropriateness to that end. *United States* v. *River Rouge Improvement Co.*, 269 U. S. 411, 419; *Port of Seattle* v. *Oregon & Washington R. R.*, 225 U. S. 56, 63.

Most of the remaining argument leading up to the final decision has to do with the interpretation, and its application to the case at issue, of Sec. 10 of the Congressional Act of March 3, 1899. This section begins

by the declaration: "That the creation of an obstruction *not affirmatively authorized by Congress,* [italics ours—Editor] to the navigable capacity of any of the waters of the United States, is hereby prohibited." The section goes on to state in detail what may not be done to interfere with navigation and ends with the qualifying clause: "unless the work has been recommended by the chief of Engineers and authorized by the Secretary of War prior to beginning the same."

The detailed argument of reasoning of the Supreme Court following the language just quoted denies the contention of the Sanitary District of Chicago and other defendants in the case that the permit granted by the Secretary of War to divert 4,167 sec.-ft. and later to increase the diversion to 8,500 sec.-ft., or any other action by the Secretary of War or other authority with jurisdiction in any way gives the Chicago Sanitary District the right to divert water from Lake Michigan for purposes of sanitation. Further on the opinion declares:

> The true intent of the Act of Congress was that unreasonable obstructions to navigation and navigable capacity were to be prohibited, and in the cases described in the second and third clauses of Section 10, the Secretary of War, acting on the recommendation of the Chief of Engineers, was authorized to determine what in the particular cases constituted an unreasonable obstruction. This construction of Section 10 is sustained by the uniform practice of the War Department for nearly thirty years.

Powers of Secretary of War

In the course of its opinion, the Supreme Court denies the claim that "the construction thus favored would constitute it a delegation by Congress of legislative power and invalid," stating that as applied to the case in point: "The determination of the amount that could be safely taken from the Lake, is one that is shown by the evidence to be a peculiarly expert question. It is such a question as this that is naturally within the executive function that can be deputed by Congress." Further on the opinion states:

> The normal power of the Secretary of War under Section 10 of the Act of March 3, 1899, is to maintain the navigable capacity of Lake Michigan and not to restrict it or destroy it by diversions. This is what the Secretaries of War and the Chiefs of Engineers were trying to do in the interval between 1896 and 1907 and 1913 when the applications for 10,000 sec.-ft. were denied by the successive Secretaries and in 1908 a suit was brought by the United States to enjoin a flow beyond 4,167 sec.-ft. Then pending the suit, the Sanitary District disobeyed the restriction of the Secretary of War's permit and increased the diversion to 8,500 sec.-ft. in order to dispose of the sewage of that district. Had an injunction then issued and been enforced, the Port of Chicago almost immediately would have become practically unusable because of the deposit of sewage without a sufficient flow of water through the canal to dilute the sewage and carry it away. In the nature of things it was not practicable to stop the deposit without substituting some other means of disposal. This situation gave rise to an exigency which the Secretary, in the interest of navigation and its protection, met by issuing a temporary permit intended to sanction for the time being a sufficient diversion to avoid interference with navigation in the Port of Chicago.
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> * * * * * * * * * * * * * * *
>
> It will be perceived that the interference which was the basis of the Secretary's permit, and which the latter was intended to eliminate, resulted directly from the failure of the Drainage District to take care of its sewage in some way other than by promoting or continuing the existing diversion. It may be that some flow from the Lake is necessary to keep up navigation in the Chicago River, which really is part of the Port of Chicago, but that amount is negligible as compared with 8,500 sec.-ft. now being diverted. Hence, beyond that negligible quantity, the validity of the Secretary's permit derives its support entirely from a situation produced by the Sanitary District in violation of the complainants' rights; and but for that support complainants might properly press for an immediate shutting down by injunction of the diversion, save any small part needed to maintain navigation in the river. In these circumstances we think they are entitled to a decree which will be effective in bringing that violation and the unwarranted part of the diversion to an end. But in keeping with the principles on which courts of equity condition their relief, and by way of avoiding any unnecessary hazard to the health of the people of that section, our decree should be so framed as to accord to the Sanitary District a reasonably practicable time within which to provide some other means of disposing of the sewage, reducing the diversion as the artificial disposition of the sewage increases from time to time, until it is entirely disposed of thereby, when there shall be a final, permanent operative and effective injunction.

Near the close of its opinion, the Court refers to the apparent fact that the legislature of Illinois and the Chicago Drainage District have long insisted "upon such a use of the waters of Lake Michigan as would dispose of the sewage of the District and incidentally furnish a navigable water route from Lake Michigan to the Mississippi basin; and that not until 1903 was the attention of the public, and especially of the District authorities, drawn to the fact that a diversion like that now used would lower the Lake levels with injurious consequences to the Great Lakes navigation and to the complainant states." Because of this interference, applications to the Secretary of War for increases in the amount of water diverted above 4,167 sec.-ft. were denied in 1907 and in 1913. The opinion then makes references to "the inexcusable delays made possible by the failure of the Federal Court in Chicago to render a decision in the suit brought by the United States." (A delay of six years, and then only an oral opinion was rendered and no decree issued prior to the resignation of the judge some two years later.)

Effect on Mississippi River

The concluding part of the opinion and decision, denying first the claims of the intervening states to the southward in behalf of Mississippi River navigation and then virtually granting the prayer of the complaining states on the Great Lakes for an injunction, subject only to expert findings to determine what time should be given to the Chicago Sanitary District to build treatment works that would make diversion unnecessary or only very small in amount, follows:

> The intervening states on the same side with Illinois, in seeking a recognition of asserted rights in the navigation of the Mississippi, have answered denying the rights of the complainants to an injunction. They really seek affirmatively to preserve the diversion from Lake Michigan in the interest of such navigation and interstate commerce though they have made no express prayer therefor. In our view of the permit of March 3, 1925, and in the absence of direct authority from Congress for a waterway from Lake Michigan to the Mississippi, they show no rightful interest in the maintenance of the diversion. Their motions to dismiss the bills are overruled and so far as their answer may suggest affirmative relief, it is denied.
>
> In increasing the diversion from 4,167 sec.-ft. to 8,500 the Drainage District defied the authority of the National Government resting in the Secretary of War. And in so far as the prior diversion was not for the purpose of maintaining navigation in the Chicago River it was without any

legal basis, because made for an inadmissible purpose. It therefore is the duty of this Court by an appropriate decree to compel the reduction of the diversion to a point where it rests on a legal basis and thus to restore the navigable capacity of Lake Michigan to its proper level. The Sanitary District authorities, relying on the argument with reference to the health of its people, have much too long delayed the needed substitution of suitable sewage plants as a means of avoiding the diversion in the future. Therefore they cannot now complain if an immediately heavy burden is placed upon the District because of their attitude and course. The situation requires the District to devise proper methods for providing sufficient money and to construct and put in operation with all reasonable expedition adequate plants for the disposition of the sewage through other means than the Lake diversion.

Though the restoration of just rights to the complainants will be gradual instead of immediate it must be continuous and as speedy as practicable, and must include everything that is essential to an effective project.

Experts to Determine Diversion

To determine the practical measures needed to effect the object just stated and the period required for their completion there will be need for the examination of experts, and the appropriate provisions of the necessary decree will require careful consideration. For this reason, the case will be again referred to the Master for a further examination into the questions indicated. He will be authorized and directed to hear witnesses presented by each of the parties, and to call witnesses of his own selection, should he deem it necessary to do so, and then with all convenient speed to make report of his conclusions and of a form of decree.

A. R. B. A. Has Large Convention Program

Ten Sessions and Forty Committee Reports Discuss Problems of Engineering, Construction, City Pavements and County Roads—Poor Attendance Characterizes Technical Meetings

AS in all recent years, the annual convention of the American Road Builders Association last week was dominated by the exhibition of road machinery held in conjunction with the business and technical meetings of the association. There was a greater volume of committee reports and technical papers than at any previous convention and they covered a wide range of subjects. Their presentation met scant attention in attendance or in discussion. The largest attendance and the most active discussions were at the sessions of the constructors. Valuable reports and papers of the county engineers' and the city engineers' divisions and at the Pan-American session were presented to audiences of less than a hundred and often without a word of discussion for a whole session. The hundreds of engineers and contractors and the thousands of manufacturers at the exhibition did not interest themselves in the professional work of the association.

Altogether the seven divisions of the association held ten sessions, one general, two manufacturers, two constructors, two county officials, one city officials, one engineers and one Pan-American. There were 40 main committee reports and papers. Many of the reports were voluminous and also were reports of progress with only tentative conclusions. They can, therefore, be only briefly defined in the space available. For example, the notable study of liens in public construction with its digest of lien and surety-bond statutes will make a printed volume of over 200 pages. There were other reports of 20 and 30 pages. Altogether the reports and papers aggregated some 700 pages. There was subject matter, therefore, which called for attendance and discussion at every session. Both were very largely lacking.

There follows a listing and résumé of the formal reports and papers. For convenience these will be grouped according to general subject.

Engineering

In the report of the committee on highway financing presented by Charles M. Upham, general manager, A.R.B.A., the two policies of quick construction from bonds and slower development using annually only current income were compared. The bonding plan was recommended when no great part of the system has been improved and it is desirable to furnish means quickly to meet the demands of traffic. When construction of the system is already well advanced or has been brought well toward completion, financing should be from current revenue. Bonds should be serial in form and should mature in not to exceed 30 years, and maturities should be arranged so that the annual payments (principal and interest) will be as nearly uniform as practicable. Sound planning and good management of the loan in bonding for road improvements is of greatest importance.

In a supplemental paper B. E. Gray, division engineer, West Virginia Highway Department, considered it unfortunate that "bond issue" and "pay-as-you-go" financing had come to be considered competitive instead of supplemental. He indicated his preference for shorter-term bonds—25-year, or better, 20-year bonds instead of 30-year. He considered that bond issues by counties for road improvement should be discouraged and that the state should refrain from raising money for state roads by direct taxation and leave this field of revenue to the counties. J. T. Donaghey, former state highway engineer of Wisconsin, took a positive stand against road financing by bonds except in rare instances and then the bonds should be for short terms of 5 to 10 years.

As chairman of the committee on a program for grade-crossing elimination, E. W. James, Bureau of Public Roads, presented a well-defined discussion based on records and experience which led to the following program: (1) a definite classification of crossings based on the relative value to the traveling public of their elimination, (2) a definite annual program of each state and each railroad in each state for the elimination of certain grade crossings of highest classification, (3) restriction of the authority to create new grade crossings, (4) a definitely progressive program in each state for installing safety warning devices of a rigidly standardized type or types, and (5) readjustment of the share of the cost of elimination and of the installation of safety devices between the railroads and the public.

A properly balanced plan of road improvement in regional heavy-traffic areas was laid down by J. Gordon McKay in a paper which first presented the principles

determined by traffic surveys. As these have been given fully in *Engineering News-Record*, Jan. 3, 1929, p. 10, by Mr. McKay himself, they will not be reviewed. The suggested plan of regional-area road development is: (1) Sufficient main arterial routes between the principal sources of traffic, (2) circulatory belt arterial routes connecting the main arterial system and providing facilities for distribution and interchange of traffic between routes and for by-passing traffic, (3) lateral or feeder routes connecting the secondary sources of traffic with the main arterial and belt-road system and (4) minor or local traffic routes. The paper aso indicated briefly the plan of improvement for the regional area of Cleveland, Ohio.

The lessons to be learned from highway research in the design and construction of city pavement subgrades and bases were summarized in a long report by C. A. Hogentogler, Bureau of Public Roads. The report was an excellent review of past survey and research results bearing on the subject. From these data the report concluded that the strong indications are that (1) oiling clay and silt subgrades may greatly reduce the possibility of their working up into flexible base courses, (2) insulating-layers of fine granular material prevent soft clays and silts from working up into base courses, (3) porous base courses reduce detrimental frost heave, (4) base courses may reduce cracking due to non-uniform support but by offering high frictional resistance to slab sliding may reduce the width but increase the number of expansion and contraction cracks, (5) drainage reduces cracking in rigid and failure in flexible pavement, (6) close-mesh reinforcement reduces initial load cracking of pavements on wet subgrade. The established facts are, (1) increased thickness decreases fine breakage due to load, (2) rich-mix bases resist load breakage better than lean-mix, (3) steel reinforcement is more economical than increased concrete thickness in reducing cracks, (4) steel reinforcement is the only means of holding cracked slabs together, (5) wearing courses on compacted base courses prevent disintegration beginning with abrasion, (6) wearing courses protect broken concrete bases from further breakage due to traffic.

Giving a record of tests comparing high-early-strength and standard portland cement, Duff A. Abrams, of the International Cement Corporation, pointed out that the outstanding characteristic of the newer material to the road builder was its rapid development of strength in 1 to 3 days. Although cements of this type sell at a premium, the additional cost should not be considered an item of expense but rather a time-saving investment. Larger and more expensive mixers are used, and batching devices and efficient concrete handling and finishing equipment are installed in order to improve quality and speed up production. A high-early-strength cement will also be found an important factor in speeding up the work and reducing the ultimate cost of the project to the engineering department, to the contractor and to the public. The progressive road builder will find many applications for this type of cement.

Presenting in full the revised and extended equipment depreciation schedule of the Associated General Contractors the committee on depreciation, W. A. Van Duzer, Pennsylvania Department of Highways, as chairman, said:

> This is a schedule of equipment depreciation by percentages. Unquestionably there will be changes in this schedule from time to time, but it is felt by your committee that this will be a working basis on about 250 pieces of equipment, the most of which are used in road construction. It is the recommendation of your committee that a committee on depreciation of equipment be made a permanent part of the American road builders' organization and that this committee work with a similar committee of the Associated General Contractors.

Construction

Six major papers dealing with construction problems covered lien laws, equipment progress, specifications, credit standardization and prequalification of contractors. In a large measure the authors outlined familiar activities, but each paper developed new thought on some of these practices.

Discussing recent changes in design and specifications as they affect the contractor, Geo. N. Childs, Cast Stone Construction Company, Eau Claire, Wis., spoke particularly of the new set-up of plant and processes required with the introduction of proportioning by weight and designing mixtures by the water-cement ratio theory. He believes that weighing is sure to become general practice, and contractors should so inform themselves that they can turn to it with ease and confidence. With the turn of practice to water-cement ratio design there is, he thought, a hazard that mixes might be stiffened so as to require new designs in mixing, tamping and finishing equipment. He preferred the practice this year in Wisconsin on a number of paving jobs of specifying a certain strength of concrete to be attained within a stated period of time, leaving the kind of aggregate, the proportions and the water content to the discretion of the contractor. Should he fail to produce a concrete of the desired strength he is penalized up to a certain point, beyond which his work is rejected. Several of these so called "quality concrete" contracts were built during the past season and were very satisfactory to the state and to the contractor.

Another change receiving serious consideration by some highway departments which Mr. Childs considered worthy of mention is the plan of taking the time required to complete the work into consideration in determining the low bidder: Briefly, the contractor is to state in his proposal the number of days he will require to complete the contract. A predetermined value per day is arrived at by the officials, usually by multiplying the miles of detour by the vehicles per day times the estimated cost per mile, it being assumed that cost of detouring is a part of the contract price. The contractor bids on time as well as on cost of doing the work, both units being considered when awarding the contract. Should the time consumed in doing the work exceed that named in the proposal tendered, an amount equal to such excess days times the value per day is deducted from the contract price. Likewise in the event a shorter period of time is used to complete the contract, a sum arrived at in like manner is added.

Four major influences were cited by S. T. Henry, of the McGraw-Hill Publishing Company, as having occasioned the great improvement in recent years in the design of construction machinery. They are (1) Automotive research and practice, (2) competition among makers, (3) competition among users, and (4) vast construction programs. Outlining the nature and intensity of these influences the author considered that they will continue to determine progress. Automotive influence is sure to be at least as effective as in the past decade. In fact the evidence now is that designers of construction equipment will be swayed more by this than by any other single factor.

Competition among makers of equipment is likely to

be keener than ever. Thus far the manufacturers in this industry have been relatively small concerns. Most of them have made a single line or closely-related lines of units. Within the last year or two, however, several mergers have occurred. Others are in the process of formation. This tendency toward the consolidation of competing and of non-competing concerns seems likely to increase; rather, it is almost inevitable. Out of the industry it appears that a few large successful groupings will come. These will be in a position to finance research and engineering work that is beyond the reach of the smaller companies. The latter, however, will remain a vital factor in the industry. In certain specialized lines the small maker may in fact be the leader in the quality and performance of product. But the coming of the bigger manufacturing units which succeed will result in economies in engineering, production, marketing and servicing that will permit constant improvement in fundamental and detail design.

Competition among users of equipment also will certainly continue keen. Their demand for greater speed, more reliability and better economy will increase accordingly. At the same time the employment of operators of higher type and of better training, of men who have real mechanical ability and knowledge, will permit refinements in design not hitherto practicable.

With even a continuation of the volume of construction work done in recent years, the market for equipment will be large. This great volume of business will continue to permit changes in design to be made rapidly.

Having in mind all of these favorable probabilities, there are likely to be few revolutionary changes in the design of equipment. The betterments will more probably come as they have in recent years; there will be better engineering, better manufacturing, better materials and a keener grasp of the needs of the user.

Describing the procedure of prequalification of bidders Ward P. Christie, engineer, Associated General Contractors, said:

> Each bidder is required well in advance of a letting to submit a sworn statement showing his experience, equipment, organization and financial worth. This may even be made a condition precedent to obtaining plans. By such means the awarding agency is given an opportunity to check the truth of the statement and also proper time in which to make a determination. The bidder's capacity of ability to perform is gauged in connection with the amount of uncompleted work on hand and the amount that he can be expected to handle successfully.
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> Some bidders who are known habitually to deliver poor work, fail to pay their bills, bribe inspectors or otherwise demonstrate their irresponsibility, would be disbarred altogether. The rest are classified according to their abilities and advised of how much work the Department is willing to award them. In the highway field when a bidder has submitted proposals on several projects he is checked on his maximum allowance. If he is low on projects to the extent of his maximum, any of his proposals still unopened are returned.
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> The benefits of this system appear very significant to both the bidder and the public body. The bidder learns his limitations before he has gone to the trouble and expense of bidding and often he is saved from disaster. Awarding officials have a chance to exercise discretion unhampered by any agencies that have a financial interest at stake. In all probability the man who can secure backing to enter the business without having a contract on hand is likely to be a more or less substantial citizen. In any even should he not be responsible these agencies mentioned have no interest in a specific bidder before the award and are not on hand to thwart the awarding official.
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> As no monetary consideration is yet involved, no charge of dissipating public moneys can be raised. No super-patriotic taxpayer can delay the award with an injunction. The public official that acts as an agent for a surety company has no opportunity to inject his hand into the situation. The promiscuous supplying of bid bonds or certified checks is circumvented. The third rate banker is relieved of some of his anxiety.
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> More specifically still the department has had a chance to learn whether equipment, which the bidder is using as collateral, belongs to himself or someone else. It can find out whether he has left a string of unpaid bills in some other locality. The investigation of every contractor expecting to do work for a public body can proceed in a thorough and orderly manner.

In a discussion of grading and paving economies by A. S. Stellhorn, contractor, Wooster, Ohio, the statement was made that equipment and men can be employed only from 40 to 70 per cent of the 300 nominal working days of the year. Noting this restriction the author pointed out that each individual and separate operation of building a concrete pavement is simple and easy. The real difficulty is to co-ordinate all of the operations. They all must go on simultaneously if volume is to be obtained. System and co-ordination are the secrets of volume production, and unless volume production is obtained the modern contractor cannot make any money, and unless he makes money he goes out of business. He said:

> Periodically groups of engineers make time studies on road construction and then road builders are told just what poor managers they are. The report is 100 sq.yd. of pavement lost due to delays on subgrade; 300 sq.yd. due to no material at the mixer; 50 sq.yd. due to the delay caused by moving water hose, etc. I am afraid that some of these well meaning critics forget that the contractor is building roads to make money, not to make records. It may perhaps be just as efficient to work twelve trucks on a road concreting job to maximum efficiency and allow for some loss in the mixing and finishing, as for the contractor to overweigh himself with hauling equipment just to keep the mixer busy.

City Pavements

The new division of city officials appeared for the first time on the program with a statement of its organization and introductory reports of committees. As organized there will be four general committees: (1) Organization, administration and finance, (2) design and construction, (3) maintenance, and (4) traffic. Each of these general committees will, as its activities develop, set up subcommittees.

At this meeting, each of the general committees presented a report designed to develop the subjects for special study by summarizing and outlining present practices. Thus the committee on administration and finance reviewed present practices in organization, method of financing new pavement particularly by assessment, contract procedure, selection of pavement types, charges for street openings and cost records. In the matter of assessments it appears that all cities use them in one form or another.

In commenting on assessments the chairman, H. C. Whitehurst, assistant engineer commissioner, Washington, D. C., pointed out that they were practiced years ago as a purely local benefit. When the laws were written undoubtedly such was the case, but today except in the case of purely local residence streets the extent of the local benefit is doubtful. Conditions have materially changed since the original assessment laws of most cities were passed. Roadways are designed and constructed today for general traffic requirements and only in a small part as local benefit.

In reviewing the subjects assigned to it the committee reached the conclusion that organization and selection of streets to be paved are problems for the individual cities. Further detailed study will accomplish little but furnish interesting data for comparison. The matter of assessment or financing for new pavements, contract procedure, financing and charges for cuts and cost records, are worthy of close study and investigation by sub-committees, one for each subject. An exhaustive investigation

and study of the various practices followed by a report with specific recommendations will be of inestimable value to all city highway officials.

The committee on design and construction divided its subject into contracts and specifications; roadway widths; subgrade; pavement bases; wearing surface; sheet railway tracks and paving, and field engineering and inspection. Important problems in each were indicated for study and effort was urged to develop standardization and recommended practices. The chairman, George B. Sowers, deputy commissioner of engineering and construction, Cleveland, Ohio, pointed out as a reason that much city paving work is still in an experimental stage. New designs, methods and materials are being adopted in different places without taking advantage of the experiences of other cities. Experience is expensive and requires years of time to be acquired. No one city official has the time or facilities to gain personal experiences on the service and merits of all the paving designs or methods and materials which are available.

The committee on maintenance, C. E. Myers, Director of Transit, Philadelphia, Pa., chairman, announced the appointment of and assignment of duties to sub-committees on pavement bases, concrete surfaces, bituminous surfaces, block pavements, street openings, street cleaning, resurfacing and salvaging and unpaved streets. The chairman stated that inquiry showed that there seems to be throughout the country a wide difference of opinion as to the best methods to be employed in maintenance work, and it is believed an effort should be made to standardize the maintenance work of the various cities and that next year the maintenance committee should make recommendations along this line. The work of sub-committee No. 5, Street Openings or Cuts, and of sub-committee No. 7, Resurfacing and Salvaging of Existing Pavements, covers, he thought, two of the most important subjects in the highway field today.

M. O. Eldridge, assistant traffic director, Washington, D. C., chairman of the committee on traffic, announced a tentative schedule of assignments for committee work as follows: Causes of accidents; rules of the road; traffic light signals and signs; parking regulations, weights and loads; traffic zoning and classification; drivers' permits; safety equipment; street lighting, and traffic law enforcement.

In conclusion the report stated that no city can expect to make any real progress in reducing accidents or in solving its intricate traffic problems until it is in position to make careful and continuous engineering surveys as to the quantity and quality of its traffic, and until it is able to say to some degree of certainty where, when, how and why accidents occur. To this end it is recommended that every city in which the traffic problem has become acute, and that means practically every large city, should establish an engineering traffic department or bureau.

County Roads

The eight committees of the county officials presented reports on economic surveys, construction, rural county maintenance, urban country maintenance, legislation, administration, equipment and finance. These were fact-finding reports—a continuation of last year's work. Summary is quite impracticable and the reports themselves present only very broad conclusions and make no definite recommendations. In brief, the committees largely report progress in their fact-finding surveys. The accumulation of facts so far is large and with continuation of the surveys will provide data for useful conclusions.

Outstanding among the new practices disclosed was aërial mapping as outlined in the report on surveys and planning by Stanley Abel, Kern County, California. In comment the report states that aërial maps have distinct advantages over the best detailed line maps of cultured areas in that they show the entire area in complete detail, showing every building, tree, pavement and structure to scale. The quick delivery of aërial maps sometimes enables the user to begin important work and studies weeks or months ahead of the time which would be possible if surface surveys had to be made and maps drawn. An aërial survey of an extensive area can be completed in a matter of months instead of a period of years, as compared to a ground survey. An important feature also is the fact that the layman is competent to read the maps as well as a trained engineer.

Aërial maps may be used to advantage in county planning for the following studies: Highway location and relocation; transportation studies; reappraisal for taxation; subdivision control; probably directional trend of improvements, and forest and grain fire prevention.

Oval Welded Poles for High-Tension Lines

For carrying high-voltage transmission lines, a new type of mild steel tubular pole, for which is claimed several important advantages over the riveted lattice poles or round stepped poles hitherto employed, is being used in Switzerland. The cross-section of the new type is oval at the base, gradually decreasing to a circular section at the top. The end is closed by a circular cap which carries the ground wire of the line. In order to minimize the amount of painting and repair work in the dangerous zone close to the wires, the arms, and also the upper part of the poles, are galvanized by a metal spraying process. The lower part is painted in the ordinary manner. On the interior a special coating of hot tar is used. The crossarms used are also made of mild pressed steel, welded to steel shoes which are fixed to the poles by means of stirrup bolts. The arms may be of any desired length, and may be used to carry overhead contact wires on railway lines.

In the manufacturing process a number of mild steel plates of a trapezoidal shape are assembled and, after being rolled into shape, welded into the pole form. The dimensions of the plates are chosen so that four or five are sufficient to make a pole 50 to 70 ft. long. By varying the size of the pole and the thickness of the plates, sufficient strength may be provided to stand whatever stress is expected in the installation. The poles are set in concrete blocks, 6 to 8 ft. thick, poured directly into a hole excavated in the ground, the poles being cemented in. This method of constructing the poles allows a shape closely approximating that theoretically required by bodies of uniform strength. The material is, therefore, very efficiently utilized. The oval cross-section allows the greatest moment of resistance to correspond to the line of highest stress. After construction, all welded joints are tested by being fixed at one end and loaded at the other to produce a stress of 10 tons per square inch.

The Swiss Federal Railways have adopted these poles in connection with the electrification of their lines and during the past few months have used several thousand of them.

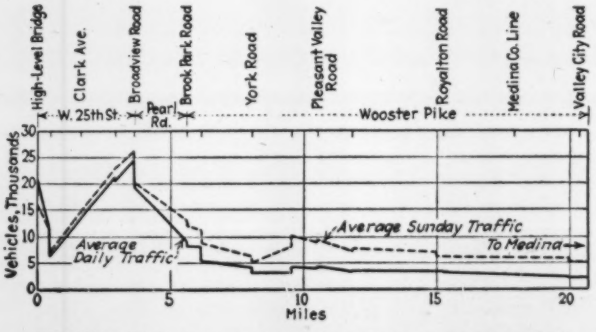
Basic Highway Data Obtained for Cleveland Regional Area

Exhaustive Survey of Traffic Situation and Needs Utilized in Laying Out Comprehensive System to Be Financed and Constructed in Next Ten Years

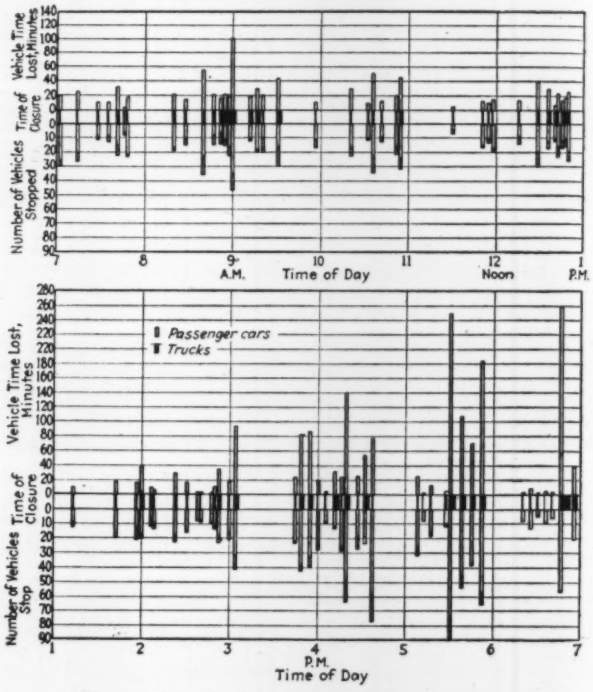
SURVEYS OF TRAFFIC CONDITIONS and studies of remedial plans both with and without physical additions to the transportation system have been made in many cities. A few regional studies of this kind have also been made. The Cleveland survey, here abstracted, is the latest. It was carried out by the U. S. Bureau of Public Roads. Since the first such comprehensive and co-operative survey—in the Chicago region, 1924—the bureau's staff has learned much. Perhaps the main thing has been insistence that all the agencies involved shall co-operate and shall agree to carry out the plan when established; also, the bureau insists on including in the area surveyed all of the territory reasonably affected without regard to political boundaries or jurisdiction. In the Cleveland survey, when all the facts had been assembled and the conferences concluded, the final plan was evolved at Washington independent of local influence. —EDITOR.

HIGHWAYS in the metropolitan region surrounding Cleveland form an incomplete transportation system, inadequate for the vehicular traffic movement into the city and between suburban centers surrounding it. The system lies mainly in Cuyahoga County, but does extend into contiguous counties. Realizing the increasing importance of this highway problem and appreciating the value of establishing a definite plan of highway improvement to serve the steadily increasing traffic demands of the area, the commissioners of Cuyahoga County requested the co-operation of the U. S. Bureau of Public Roads in a study of highways and traffic and in the establishment of a scientific plan of highway improvement.

After a preliminary study, the area selected for the survey, designated as the Cleveland regional area, was established within a semicircle of approximately 30 miles radius about the center of the city of Cleveland. Resolutions agreeing to co-operate in the establishment and improvement of highways as determined by the survey were adopted by substantially all highway administrative organizations in the area. The co-operative survey was formally approved by the Bureau of Public Roads, the Ohio State Department of Highways, the seven boards of county commissioners and (within Cuyahoga County)



TRAFFIC DENSITY ON WOOSTER PIKE FOR 20 MILES
Daily and Sunday traffic has same general characteristics.



VEHICULAR LOST TIME AT GRADE CROSSING
Periods of time when gates were closed on Lorain Ave. crossing of the New York Central Railroad number of vehicles stopped and time lost from 7 a.m. to 7 p.m., Nov. 11, 1927.

by the cities of Cleveland, East Cleveland, Cleveland Heights, Lakewood, 42 villages and seven townships. The cost of the survey was shared equally by the Bureau of Public Roads and Cuyahoga County.

Major causes of the unsatisfactory condition of the highway system are: (1) Lack of a plan to which all agencies could work; (2) absence of centralized authority; (3) deferred reconstruction of arterial routes; (4) too few arterial routes; (5) convergence of arterial routes in Cleveland, causing congestion; (6) narrow pavements, grade crossings, car lines, car-loading platforms, parked vehicles and location through highly developed business and industrial districts, resulting in congestion and low capacity; (7) unimproved or poorly improved sections on arteries, resulting in uneconomic, indirect movement of traffic; (8) physical obstructions such as rivers, industrial developments, railroad yards and parks, which have hampered improvement of present routes and development of new ones.

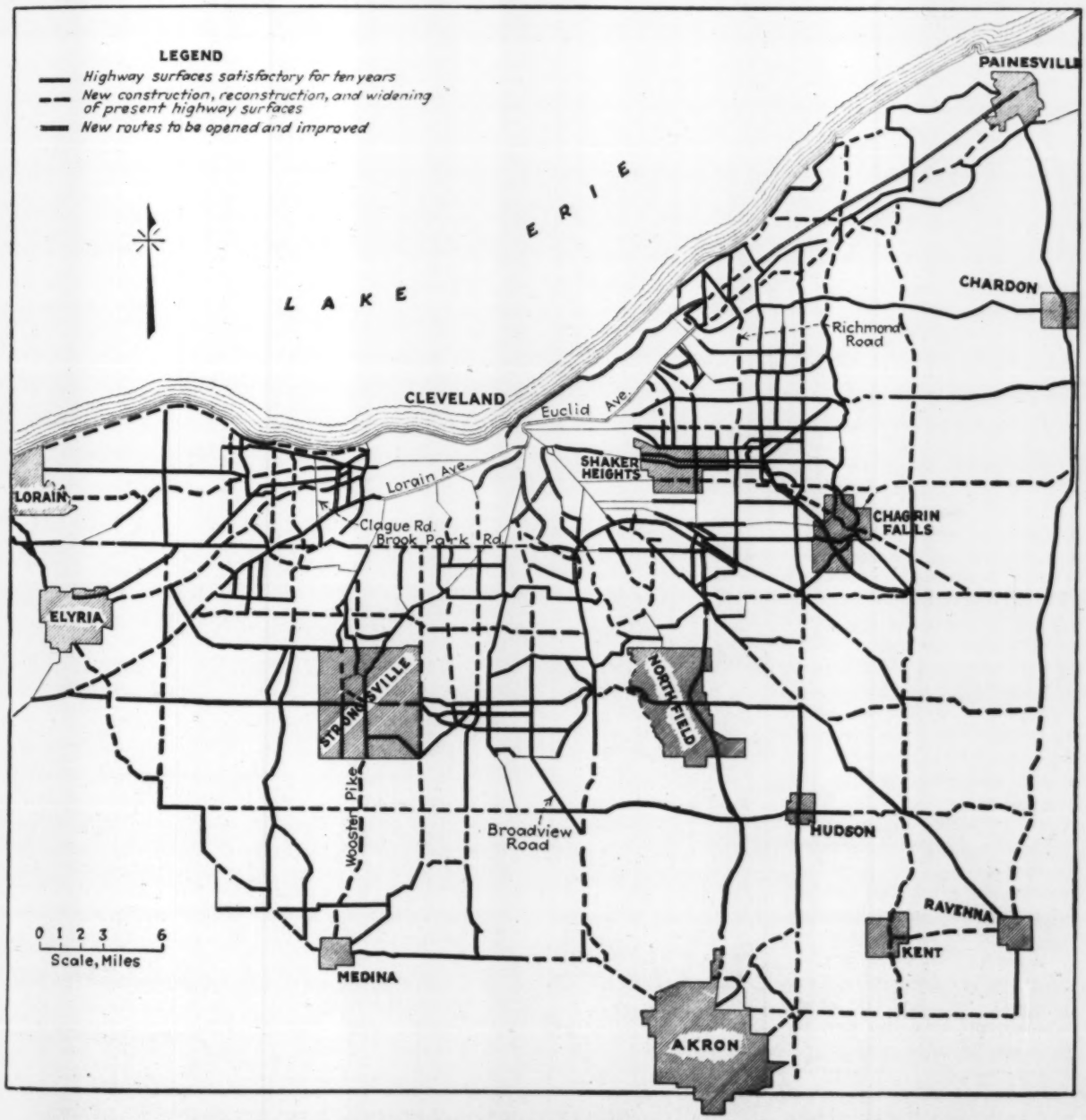
Outside the cities of Cleveland and Lakewood the survey covered 654 miles of highway in Cuyahoga County, which have been classified as of major, medium and minor traffic importance. Major roads—those on which traffic now is or by 1937 will be more than 1,800 vehicles a day—comprise 291 miles. Medium-traffic roads—those between 700 and 1,800 vehicles a day—

comprise 133 miles. The rest of the mileage is of minor traffic importance; roads in this class now serve a traffic of 400 vehicles a day or less and it is estimated that their traffic will not exceed 700 vehicles a day by 1937.

Of the major-traffic mileage, 62 per cent (179 miles) is now in satisfactory condition to serve traffic demands during the next ten years or is under contract for adequate improvement. Of the mileage of medium-traffic routes, 53 per cent (70 miles) will be satisfactory for the ten-year period. Only a comparatively small mileage of minor-traffic road will require reconstruction or widening during the period of the plan.

The remainder of the principal traffic routes (38 per cent of the major-traffic routes and 47 per cent of the medium-traffic routes) of the existing system are in an unsatisfactory condition. There are in addition a considerable number of unimproved gaps in the present system and a lack of arterial routes and connections.

Certain definite information in the survey is of general interest in comparison with that of other regions. For instance, local passenger-car traffic on fifteen main routes was found to be 99.6 per cent of the total. Sunday traffic is the heaviest, except in the business section, and the maximum hour is between 4 and 5 p.m., when it amounts to 10 per cent of the day's total. On weekdays 5 to 6 p.m. is the maximum hour. The greatest 24-hour density found was 56,000 vehicles, on the Superior St. or high-level bridge. Carnegie Ave. at East 55th St. carries 38,000, and Superior at the same street 33,000. Counts of densities at 7, 10 and 13 miles out show from



EXISTING AND PROPOSED ARTERIAL HIGHWAYS IN CLEVELAND REGION

A regional system good for ten years is here laid out irrespective of political boundaries. The various roadbuilding agencies have agreed to construct on this plan.

one-third to one-half drop of the high-count roads (more than 10,000) in the 7 to 10 mile stretch, while at 13 miles out the traffic on these same roads falls to 22 to 46 per cent of that at 7 miles out. These studies indicated the need of relief roads in certain areas.

The present zone of heavy traffic in Cuyahoga County corresponds generally with the area of Cleveland and the important suburban development — approximately within the limits of Clague Road on the west, Pleasant Valley Road on the south and Richmond Road on the east. Outside of this area large volumes of traffic are found only on the principal arterial routes connecting Cleveland with adjacent centers of population such as Akron, Lorain, Elyria and Painesville. With continued suburban development the zone of heavy traffic will expand slowly, but the change during the next ten years is expected to be primarily an extension along the present main arterial routes rather than a general expansion of the area.

Convergence of the principal traffic routes produces a concentration of traffic far in excess of the normal traffic capacity of present routes coming into the city. An adequate highway system must provide relief for each of these congested sections and provide solutions that will prevent future congestion. The most satisfactory method of providing such relief is to distribute and diffuse traffic over a series of parallel routes and prevent the concentration of such great volumes of traffic on a comparatively small number of routes. The alternative is widening the existing main arteries, which are frequently through areas so highly developed as to make the cost of widening prohibitive.

Full use will be made of available right-of-way width on these routes; but wherever practicable the solution sought is to develop parallel distributing routes either by the establishment of new highways or by the development of proper connections between existing routes and by the completion of gaps which now exist. This method of solution is the basis of the plan formulated for new routes and connections. It is considered best from the standpoint of both effective distribution of traffic and cost of the improvement.

The capacity of an entire route may be greatly reduced by a relatively short throttling section, on which the number of traffic lines is less than on the remainder of the route.

Wherever a main arterial route passes through a local business, theatrical or other amusement area the parking problem becomes critical and street capacity is reduced by cars seeking a parking place and by delivery trucks. These conditions are clearly illustrated on Euclid Ave., with minimum roadway width of 50 ft. (five traffic lanes), which is frequently reduced to two active lanes due to street-car loading platforms and vehicle parking. In the vicinity of the East 105th St. business and theatrical district the traffic capacity is materially reduced by slow-moving local traffic. Where Euclid Ave. crosses this area the traffic speed during the peak hour was only 9 m.p.h.

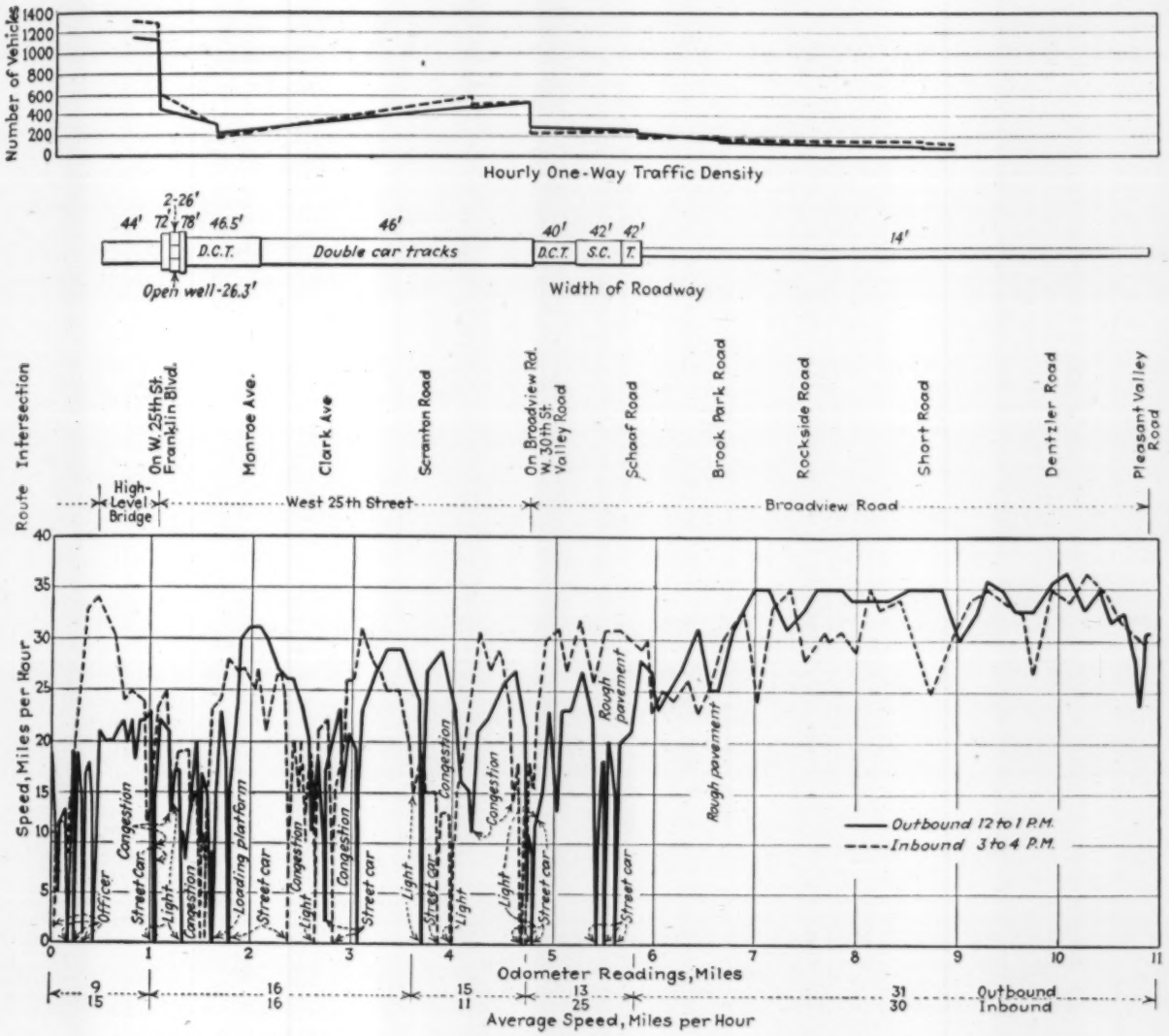
Where main traffic arteries cross important rail lines at grade a marked reduction of traffic capacity of the route occurs, and in addition the crossing constitutes an accident hazard. The Lorain Ave. crossing of the main line of the New York Central Railroad is blocked 20 per cent of the time between 7 a.m. and 7 p.m., and more than 30 per cent of the vehicles using this heavily traveled route are stopped at the crossing by the closing of the highway for train movement.

Registration data indicate that traffic in Cuyahoga County will increase 73 per cent during the next ten years, with corresponding congestion unless relief is provided.

On the basis of traffic-capacity studies it was determined that the traffic capacity of a two-lane roadway under open road conditions at a traffic speed of 25 m.p.h. is approximately 10,000 vehicles per day. Under suburban conditions, with a limited amount of parking adjacent to the roadway and a larger volume of cross-traffic and local traffic, the capacity of a two-lane roadway is reduced to 8,000 vehicles per day. Routes now carrying or expected to carry 8,000 or more vehicles per day within the zone of Clague Road, Pleasant Valley

MOTOR VEHICLE TRAFFIC ON STATE AND COUNTY HIGHWAYS IN THE VICINITY OF CLEVELAND

Only principal trunk lines are shown, but 654 miles in Cuyahoga County alone were covered. Note heavy eastern traffic on one road only, while that to the west is split up three ways.



THREE DIAGRAMS THAT SHOW RELATION OF TRAFFIC DENSITY, SPEED AND ROADWAY WIDTH
Results from outbound and inbound trips on West 25th St. and Broadview Road from Public Square.

Road and Richmond Road should therefore be planned as 40-ft. roadways (four lanes). Routes outside of this zone expected to carry in excess of 10,000 vehicles per day should be similarly improved.

The Plan—The first requirement of the plan is to utilize the present routes to the fullest possible extent. This involves a program of widening and reconstruction of surfaces and structures, and new construction.

Certain sections of the area are inadequately served by present highways owing to lack of direct routes. In other sections the traffic demand exceeds the capacity of existing routes even after improvement, so that new routes must be developed. These are planned without railroad crossings at grade. The plan also includes the elimination of the most serious grade crossings on existing routes and protection of crossings on minor-traffic routes. Provision is also made for separation of grades at highway intersections and for circular intersections on the new routes.

A total of 595 miles of highways is to be improved. Of these 127.4 miles is new route (67.8 miles of 40-ft. pavement and 59.6 miles of 20-ft. pavement). New construction is planned on 76.2 miles and reconstruction on 391.3 miles. Four new bridges, exclusive of those on new routes, are to be built and seventeen replaced and widened; 55 grade crossings are to be eliminated.

The cost, given as $63,078,000, is to be budgeted over a ten-year period. It is well within the financial ability of the counties concerned. Cuyahoga County will bear $41,203,000 of the total.

Bureau of Standards Measures Physical Properties of Commercial Cast Stones

The compressive strengths of cast stones in the form of 2-in. cylinders, 2 in. long, have been found by the Bureau of Standards to vary within wide limits, with an average value of 6,250 lb. per sq.in. On account of the increasing use of this product as a building material there is a demand for knowledge of its physical properties, more particularly resistance to weathering, so that acceptance specifications may be intelligently written. While freezing resistance as a measure of durability is a most important property, the bureau believes such a requirement in the specification is impracticable. Determinations of other properties such as strength and absorption, have been made to discover any possible correlation between them and freezing resistance.

News of the Week

New York Central Offers Plan for West Side of Manhattan

Offering the City of New York a definite agreement for the grade eliminations in the west side of Manhattan the New York Central Railroad has taken another step in the solution of a long-discussed problem. The new plan is similar in most respects to that submitted by the railroad company some five years ago (*Engineering News-Record*, Dec. 6, 1923, p. 947). The railroad agrees to abandon its St. John's Park yard and all tracks south of Canal St., elevate from the Spring St. terminal to west 30th St., and depress the tracks from the 30th St. yard north to 60th St. The yard at 30th St. will be enlarged.

Several concessions by both the city and the railroad are suggested. The railroad offers easement rights over the tracks for highway purposes from 60th St. north. A four-track lift bridge is proposed across the Harlem ship canal, with the right granted to the city to place a highway deck on the bridge above the tracks.

President Crowley, of the New York Central, says that in offering the definite agreement hopes are held for early action by the Transit Commission, which has jurisdiction over grade crossing elimination. The Hofstadter Bill of the New York State Legislature, passed last year, (*Engineering News-Record*, Apr. 12, 1928, p. 604) provided for negotiations between the state, city and railroad for the proportionate share of the cost to be borne by each. The present agreement offered by the railroad company does not state the amounts to be paid by the three parties.

The railroad expects to electrify its west side operations.

Missouri Court Upholds Right to Form Drainage Districts

Judge Ira D. Beals of the Thirty-sixth Missouri judicial district in the Livingston County Circuit Court at Chillicothe, Mo., on Jan. 17 upheld the constitutionality of the law passed by the Missouri General Assembly in 1913 granting the right for the organization of drainage districts in the state. The decision was handed down in passing on quo warranto proceedings filed by Carl H. Gantz at the relation of Joseph L. Shy, Prosecuting Attorney, against the Grand River Drainage District of Livingston and Linn Counties.

It was contended the act of 1913 deprived property owners of an opportunity to be heard on the question of utility and necessity for the construction of drainage districts and thus violated the Constitution of Missouri and also of the United States. The dissolution of the district was sought. The bonds involved in the proceedings total $500,000.

Cutting Down Spillway of Lake Pleasant Dam Recommended

Immediate lowering of the spillway of the Lake Pleasant multiple arch dam in Arizona to an elevation 130 ft. above stream bed is recommended by a committee of engineers appointed by State Water Commissioner Frank P. Trott. As was reported in these pages last week, vertical cracks in the buttresses and question of the foundations of the dam caused concern for the safety of the structure. The committee further recommends that if the water district is unable to obtain funds for strengthening the dam the spillway should be cut to an elevation 120 ft. above the stream bed. The state legislature will be asked to supply funds.

Lackawanna Builds New Pier

The Delaware, Lackawanna & Western Railroad has awarded a contract to Foley Bros. of New York & St. Paul, for the construction of a new 1,200-ft. pier of wood pile and concrete deck design in the Hudson River at Hoboken, N. J. The pier will be 40 ft. wide and will carry tracks for a traveling revolving crane for freight handling. The timber grillage supporting the deck will rest on wood piles 100 ft. long.

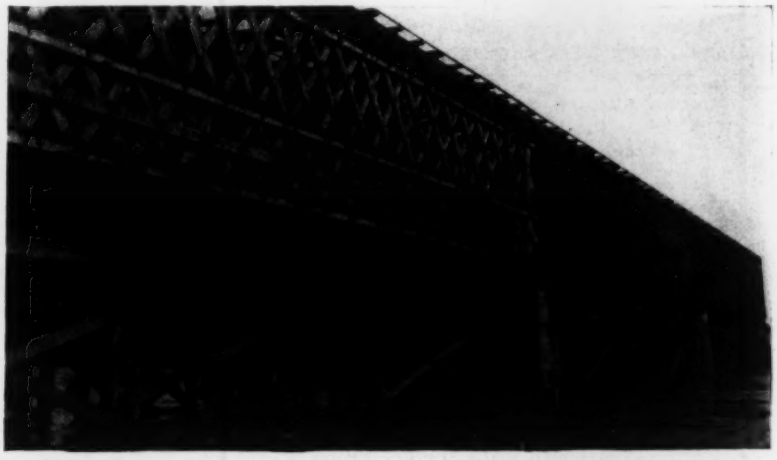
Fire Destroys Formwork on 34th Floor of New Chicago Building

Overturning of a salamander and the spilling of hot coals on tarpaulins spread over freshly-placed concrete floors caused a fire which destroyed the formwork and temporary construction timbering above the 34th floor of the new 42-story Foreman National Bank Building, Chicago, on January 13. Hose carried up the steel stairway and lines connected to standpipes of adjacent tall buildings were used in fighting the fire. A high wind carried blazing timbers for some distance, but the presence of snow on the roofs enabled firemen to prevent the spread of the fire. Early estimates place the damage at $3,000, without any examination as to the effects of the fire on the structural steel.

Illinois Completes 1,294 Miles of Hard Roads in 1928

During 1928 Illinois completed 1,293.5 miles of pavement, 301 miles of heavy grading done in advance of the paving and built 304 separate drainage structures. The yardage of paving laid is estimated to be about 14,162,730 sq.yd. The mileage built includes about 39 miles of pavement 40 ft. in width, located in the metropolitan area of Chicago, and the remainder is practically all 18 ft. in width, except for a small mileage of 20-ft. roads.

BRIDGE SERVICEABLE AFTER 41 YEARS



Increased loading requirements and damage by flood has made it necessary to dismantle a lattice-truss timber bridge on the Maine Central Railroad at Lunenburg, Vt., which was built in 1887. The railroad plans to use the old trusses in other locations for highway overpasses. The illustration shows the left span with the sheathing removed to reveal the web construction. Most of the framework was made of 3x12-in. spruce planks held in place by 2-in. oak pins, with ¾-in. bolts to prevent spreading of the members. The only treatment used was a coat of whitewash on the interior. Piling was driven beneath the spans in 1901 to increase the capacity of the bridge.

Col. Graves Appointed Member of Miss. River Commission

The Senate Committee on Commerce has voted to report favorably the nominations of Brig.-Gen. Thomas H. Jackson and Colonel Ernest Graves as members of the Mississippi River Commission. General Jackson was made president of the Commission last June by a recent appointment.

Colonel Graves is qualified for the position not only by his long training as an army engineer but also by reason of actual experience during flood periods on the lower Mississippi. As district engineer at Vicksburg during the floods of 1912 and 1913 he was able to obtain first-hand information of conditions brought about by the highest stages recorded until the 1927 floods.

After graduating from the University of North Carolina Mr. Graves entered West Point, completing his course there with the class of 1905. He finished second in his class. During his early service in the corps of engineers, he was assigned to duty at Fort Leavenworth, Kansas, and later at Fort Riley, in the same state. He also served under General Black in Cuba in the department of public works. In 1909 he was dispatched to the Phillipines and placed in charge of construction of fortifications at the entrance of Manila Bay. Leaving Manila in 1911, he was given his first assignment in river and harbor work at Dallas.

He served in France from the beginning to the end of the World War. For this service, which included the construction of military railroads, barrocks, airplane fields, ammunition depots, and base hospitals, he was awarded the Distinguished Service Medal. Immediately after the armistice, he went to San Antonio as district engineer and a few months later retired from active service with the rank of colonel.

During his period of retirement, he engaged in consulting engineering work. Recalled to active service, during the floods of 1927, he took a leading part in the drafting of flood control plan that was adopted by Congress.

East Boston Tunnel Proposed

A bill has been filed with the Massachusetts State Legislature providing for the construction of a vehicular tunnel between convenient points in Boston and East Boston. The tunnel would be built and operated by the city of Boston and all construction, except that done by the Transit Department of the city, would be by competitive bidding. The tunnel would be financed by city bonds to run not more than 50 years and capable of retirement at the end of 25 years by means of a sinking fund.

The Transit Department would maintain and operate the tunnel on a toll basis. In connection with building of the tunnel, the street commissioners would be authorized to proceed with the widening, relocating or rebuilding streets to provide adequate approaches.

Brief News

THE DOLLAR LINE STEAMSHIP "President Jackson" has been reserved for the United States delegation to the World Engineering Congress to be held in Tokyo next fall. The ship sails from San Francisco Oct. 11. Elmer A. Sperry, chairman of the American committee, has announced that 90 local committees throughout the United States, Canada, Mexico and the Canal Zone have been established to promote interest in the congress.

CONSTRUCTION OF NEW BUILDINGS and other permanent improvements toltaing $600,000 are under way at Mississippi A. & M. College.

PENSACOLA, FLA., WANTS the entrance of Pensacola Bay deepened to 40 ft. Government engineers do not favor a channel deeper than 35 ft. The entrance at present will accommodate ships with draft up to 30 ft.

THE GRAIN ELEVATOR COMPANY, Windsor, Ont., in co-operation with the Michigan Central Railway, is planning to erect an elevator and a 5,000-barrel daily capacity flour mill on the water front at Windsor. It is expected that construction of the first unit, costing $1,250,000, will begin as soon as possible so as to have it completed next July.

THE MARYLAND PUBLIC SERVICE COMMISSION has granted authority to the Chesapeake Bay Bridge Company to proceed with plans for the construction of a bridge over the Chesapeake Bay. When the plans are advanced sufficently the company is expected to appear before the commission and present a detailed statement concerning the project. The application filed by the company was for authority to exercise a franchise granted two years ago by the Maryland General Assembly.

Oppose W.&L.E. Plan to Use New Cleveland Terminal

A request to the Interstate Commerce Commission by the Wheeling & Lake Erie Railroad to abandon its present Ontario street station in Cleveland and enter the new union terminal is opposed by the Pittsburgh & West Virginia Railroad, owner of 70,000 shares of W. & L. E. stock. The objection states that the Wheeling application was made by directors illegally holding office and was without consent of two-thirds of the stockholders. It is also asserted that it is "an attempt upon the part of the B. & O., New York Central and Nickel Plate to force applicant to use the facilities of terminals and thereby contribute to the excessive cost of erecting, maintaining and operating terminal's railroad and union depot."

The W. & L. E. seeks to use temporarily the tracks and station facilities of the Erie and the Big Four Railroads.

Hydro-Electric Program is Announced for Canada

The British Columbia Electric Railway Company has just announced a hydro-electric expansion program involving an expenditure of approximately $8,250,000. The new plans call for the construction of another hydro-electric project on the Stave river at Ruskin and an enlargement of the development under way at Bridge River. The Ruskin undertaking is to cost $7,250,000, while $1,000,000 will be required for the change in plans at Bridge River.

The initial installation at Ruskin will develop 43,000 horse power in one generator, but foundations will be laid for another generator of the same size for future installation. Situated 3½ miles below Stave Falls, the new plant will operate on a head of 125 ft. as compared with 115 ft. at Stave Falls and together these plants will utilize practically the entire fall of water from Stave lake to the Fraser river. The dam on which work will commence immediately will be of concrete with a maximum height of 183 ft. and a length of 325 ft.

It is announced that the change in plans at Bridge River may slightly delay completion of the first stage of that project. It had been the previous intention ultimately to enlarge the tunnel now being driven to twice its size. The new plans call for immediate enlargement of the tunnel.

Arizona Preparing Plans for $50,000,000 Road Program

The state highway commission of Arizona has requested State Engineer W. W. Lane to prepare a comprehensive program of development of Arizona's highways and bridges which would pave all of the trunk highways of the state and provide better bridges where necessary. This request was made in a resolution adopted by the Arizona highway commission which is intended to direct official and legislative attention to the need of such a development program.

The plan of development would extend over 10 years and involve in round figures, $50,000,000.

Construction to Start on Power Project on Winnipeg River

Development of the power site at Seven Sisters Falls on the Winnipeg River in Manitoba will be begun at once by the Northwestern Power Company, subsidiary of the Winnipeg Electric Company. The sum of $15,000,000 has been appropriated for the work. The Carter-Halls Aldinger Company, of Winnipeg, has been awarded the contract for the construction of the concrete dams, spillways and sluice gates, together with the concrete foundations and structures for the power house. The initial capacity of the development will be 112,000 hp., with an ultimate capacity of 225,000 hp.

Dardanelle Highway Bridge Over Arkansas River Dedicated

The new Arkansas River highway bridge at Dardanelle, Ark., was dedicated and opened to traffic on Jan. 17, with ceremonies led by Gov. Parnell. Eight through truss spans totaling 2,043 ft. in length, one of which is a 362-ft. swing span, make up the bridge, built at a cost of $600,000. The new structure replaces an old pontoon bridge resting on 72 pontoons, which was built in 1890 and had to be brought to shore during flood stages.

The Lakeside Bridge & Steel Company of Milwaukee built the new bridge.

Canada to Burn Out Ice Jams

The Canadian Government will spend $60,000 this winter in an experiment of burning out ice on the St. Lawrence River by the thermit process. A contract has just been made with Professor Howard T. Barnes of McGill University, Montreal, in an attempt to obviate the disastrous floods which occurred last spring in the east end of Montreal, causing much damage. Ice from Lakes St. Louis and St. Francis drifted down and piled up in a jam upon the unbroken ice in the river below the city.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Senate Flood Control Hearing—Flood Aid for Interior Florida—Interior Dept. Wants Consultants

ALL efforts on the part of Mississippi valley interests to persuade General Jadwin that his interpretations of the flood control act, with regard to payments for flowage and other damages, are incorrect, have been unavailing. After a conference with General Jadwin on Jan. 19, lower valley interests decided to press for passage at this session the joint resolution expressing the sense of Congress that payments by the United States for such damages should be made under the flood control act.

Some additional information as to the position of the Corps of Engineers in flood control matters was revealed at the hearing, at which the Senate Committee on Commerce cross-examined Brig.-Gen. Thomas H. Jackson, when his nomination for the presidency of the Mississippi River Commission was under consideration. In answering a question as to his policy with regard to securing flowage rights from railroad and highway authorities General Jackson said:

"I have obtained no flowage rights for railways or highways. I have no authority to do this. The actual obstruction caused by embankments to flow of water is not as great as is sometimes supposed because water flowing over an earthen embankment will soon make openings sufficient to carry any discharge that the area below the embankment will accommodate. In addition, railways and highways are not always high and in many cases sufficient openings are already provided.

"The embankments referred to are believed not to be serious obstructions since in many cases they are low and already have sufficient openings. While in the past there has been some damage to the railroads, it has apparently been too limited to warrant any raising and further trestling of tracks. It is believed that the interest on the capital required to raise and trestle the railroads would far exceed the occasional damages suffered."

At another point in his testimony General Jackson said:

"The adopted plan contemplates that protection will be provided against a maximum flood predicted as 3,000,000 sec.-ft. at Old River. As much water as this does not continue to the Gulf, for 3,000,000 is an instantaneous peak at Old River. It is to be divided so that 1,500,000 sec.-ft. starts through the Atchafalaya Basin (including the Atchafalaya River) and 1,500,000 sec.-ft. starts down the main channel. Both flows will flatten out as they travel toward the Gulf. The half in the Atchafalaya Basin will flatten considerably, so that the discharge at Morgan City will be much less. About 250,000 sec.-ft. is to be taken from the main river at Bonnet Carré, leaving about 1,250,000 sec.-ft. to go by New Orleans at a stage of about 20 on the gage. As a matter of fact the flattened flow in the latitude of Morgan City should be about the same as the flow past New Orleans.

"The basis of the adopted plan is to cease taking from the main river flowage areas which nature gave it. The river needs more room than plans made in first years have assigned to it. The plan also contemplates no more levee raising than is absolutely necessary and no more raising of flood heights."

Lake Okeechobee Flood Relief

In considering flood relief legislation for the Lake Okeechobee district in Florida, it has become apparent that the House Flood Control Committee is disinclined to adopt a definite measure before it receives reports from the Army engineers on the destruction caused by the last hurricane. The only facts on the situation that the committee have at present are contained in reports prepared before the last storm. It is expected that the engineers will be able to complete their final reports on the matter in sufficient time to enable Congress to take action this session.

Although the members of the flood control committee for the most part have expressed a desire to aid the cause of flood prevention in the Everglades territory, considerable difficulty is being experienced in finding a Federal question to use as the basis of legislation. Under the plans proposed by Florida interests, the Federal Government would be required to pay half of the cost of enlarging the two outlets of Lake Okeechobee and of building a levee around the southern end of the Lake. The intervention of the United States is justified, according to these interests, because of the necessity for protecting navigation on the lake.

Consultants for Interior Department

An extension of the Interior Department's authority for consulting experts in connection with its reclamation projects is provided in a bill recently recommended to the House by the Committee on Irrigation and Reclamation. The measure as reported to the House is practically the same as the one that passed the Senate last session, except that the recent bill increases the number of consulting engineers, geologists, and economists that may be employed on any one project from three to five. The House bill also increases the maximum compensation that may be paid to a consulting expert during any one year from $3,500 to $5,000. It is provided further that the rate of compensation must not exceed $50 a day.

At present the Reclamation Service can only employ consulting engineers for work on proposed dams. No engineers may be employed for consultation purposes in connection with dams already constructed at rates necessary to secure the services of engineers of the desired qualifications. The limitation of existing authority was forcibly emphasized, according to a letter from the Department, when it was desired to employ competent engineers to examine the Reclamation Bureau's dams after the St. Francis disaster. The services of economists are essential to aid in determining the feasibility of projects while it is important for geologists to examine the sites for reservoirs and dams.

Cost and Contracts

E. N.-R. Index Numbers

Cost		Volume	
Jan. 1, 1929	**209.40**	**December, 1928**	**244**
Dec. 1, 1928	210.16	November, 1928	251
Jan. 1, 1928	203.90	December, 1927	319
Average, 1928	206.78	Average, 1928	287
Average, 1927	206.24	Average, 1927	263
1913	100.00	1913	100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Jan. 22, with some comparisons, total as follows:

(In Thousands of Dollars)

	Jan. 22, 1929	Jan. 15, 1929	Jan. 24, 1928
Building:			
Industrial	$1,355	$53,444	$3,482
Commercial	35,780	37,813	19,312
Streets and roads	6,918	6,271	3,240
Other eng. constr.	21,712	64,154	6,316
Total	$65,765	$161,682	$32,350
Total, all classes, Jan. 1 to Jan. 22:			
1929			$345,320
1928			202,983

Personal Notes

HORACE M. ALBRIGHT has been appointed Director of the National Park Service, succeeding STEPHEN T. MATHER, recently resigned on account of ill health. Mr. Albright is a graduate of the University of California and has been with the Department of the Interior assigned to the National Park Service since 1915. In recent years he has been field director of National Parks and since Mr. Mather's illness has served as acting director.

WILLIAM W. LANE, former chief engineer of the Arizona state highway department, was appointed state engineer by Gov. J. C. Phillips. Mr. Lane succeeds WILLIAM C. LEFEBVRE. C. C. SMALL, former engineer of surveys, is first assistant chief engineer, in charge of field work. W. R. HUTCHINS, former construction engineer, is office engineer for the Arizona state highway department. R. C. PERKINS, who was maintenance engineer in the southern district, succeeds Mr. Hutchins.

J. H. LONG, division engineer for the Ninth Division of the Missouri State Highway Department at Willow Springs, Mo., since May, 1922, has been transferred to the state headquarters at Jefferson City. C. W. FRANCISCO, for the past two years at the headquarters in Jefferson City, has succeeded to Mr. Long's former post.

JOSEPH F. SILER, Lieut. Colonel, U. S. Army, has been designated by the Secretary of War as chief health officer of the Panama Canal Zone, succeeding Col. WESTON P. CHAMBERLAIN. Colonel Siler served three years as chairman of the Army Medical Research Board in the Philippines and is president of the American Society for the Study of Tropical Medicine.

FONS A. HATHAWAY has resigned as chairman of the State Highway Department of Florida.

GEORGE W. CRAIG, HUGH W. SKIDMORE and MORGAN P. O'BRIEN announce the formation of the firm of Craig, Skidmore & O'Brien, Inc., of Chicago corporation of engineers offering its services in consultation, development and management, appraisal, investigation, design and construction. Mr. Craig, engineer for the office of the Asphalt Association until that office was closed the first of the year, has served the cities of Omaha, Neb., and Calgary, Alta., as city engineer. In Omaha he was at one time member of the consulting firm of Rosewater & Craig. Mr. O'Brien, consulting engineer, City of Decatur, was formerly in the engineering department, Illinois Central R.R., chief engineer of construction of Illinois Traction System and the A. E. Staley Mfg. Co. Mr. Skidmore is president of the Chicago Paving Laboratory, Inc. Mr. Craig is president, Mr. O'Brien, vice-president and Mr. Skidmore, secretary-treasurer of the new corporation.

Engineering Societies

CALENDAR

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; annual convention, Detroit, Mich., Feb. 12-14.

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; annual general and general professional meeting, Hamilton, Ont., Feb. 13-15.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; annual convention, Chicago, Ill., Feb. 18-22.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; annual convention, Chicago, March 5-7.

* * *

THE KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS will hold its eighth annual meeting Feb. 6 at Louisville, Ky.

THE ENGINEERS CLUB OF PHILADELPHIA will discuss the general subject of concrete construction on roads and structures at its meeting Feb. 19. There will be two sessions of the meeting, from 2 to 5 p.m., and from 7:30 to 10:30 p.m., with a dinner at 6 p.m.

THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA heard Maxwell M. Upson, vice-president and general manager, Raymond Concrete Pile Company, and E. K. Morse, consulting engineer, Pittsburgh, at the Civil Section annual meeting, January 8, in Pittsburgh. Mr. Upson gave an illustrated talk on "Precast Concrete Piles and Special Equipment for Handling and Placing," citing as examples the Lake Pontchartrain bridge, the San Mateo bridge and the James River bridge. Mr. Morse spoke on river terminals and docking facilities.

W. W. LANE, chief engineer of the Arizona Highway Commission since 1924, was recently appointed state engineer of Arizona. After serving six years as county engineer of Pinal County, in 1923 Mr. Lane became assistant state engineer, which position he resigned in the following year to become chief engineer of the highway department. Mr. Lane is a past-president of the Arizona Section of the American Society of Civil Engineers.

FRED. G. NELSON, formerly with the Currie Engineering Company, of Webster City, Iowa, and the Engineer Experiment Station at Iowa State College, is now with the Dorr Company, Chicago, in the sales department of the Sanitary Engineering Division.

ARTHUR E. GORMAN, formerly chief sanitary engineer, Department of Public Works, City of Chicago, and more recently public health engineer for the Sanitary District of Chicago, has joined the staff of Wallace & Tiernan Company, of Newark, N. J., on sales promotion work. He has long been associated with water-works and public health bodies and devised the system for supervision and control over the chlorination of Chicago's water supply.

G. W. MAXON, of Dayton, Ohio, recently supervising engineer for the U. G. I. Contracting Company, of Philadelphia, in charge of lock and dam construction on the Ohio River, has left the U. G. I. company to become associated with the Wiley-Maxon Construction Company at Dayton, Ohio, general contractors specializing in river foundation work.

EDWARD H. TEMPLE, JR., vice-president and general manager of the Aberthaw Company, Boston, Mass., with which concern he has been actively associated for the past twenty years, has resigned to become the head of a new company, Temple & Crane, Inc., which will engage in a general construction business, with offices in the Chamber of Commerce Building, 80 Federal St., Boston, Mass. GEORGE A. CRANE, Mr. Temple's chief associate in the new enterprise, has during the last six years been estimating engineer of the Aberthaw Company.

Obituary

CHARLES H. KLUEGEL, veteran civil engineer of Honolulu, died in that city Jan. 10, at the age of 81. Since 1888 he has been interested in railroad, waterworks and irrigation projects in the Hawaiian Islands. He was for a long time chief engineer of the Oahu Railway & Land Company and the Hilo Railroad Company. Before going to Hawaii, Mr. Kluegal spent twenty years in western United States on river and tide land surveys, reclamation surveys and served as locating engineer for the Northern Pacific Railway. Similar work took him to Mexico for a while on the Pacific line of the Mexico Central Railway.

Mr. Kluegal graduated from Union College in 1867. His son, Harry Kluegal, is present city manager of Sacramento, Cal.

JAMES WATSON, civil engineer with R. Waddington & Sons of Hoboken, N. J., died January 19 at his home in Jersey City. For many years Mr. Watson was with the W. H. & F. W. Cane Company, contractors of Jersey City.

HAROLD J. MAUSNER, graduate of Rensselaer Polytechnic Institute, class of 1927, was killed in an automobile accident near Somerville, N. J., Jan. 7. He was a resident of Carteret, N. J.

JAMES J. DOYLE, president of the Washington, Baltimore & Annapolis Electric Railroad Company and of the Annapolis & Chesapeake Bay Power Company, died suddenly at his home in Baltimore on Jan. 19. Death was due to heart disease. Mr. Doyle served as a construction engineer in building the railway of the Eastern Ohio Traction Company and later came to Baltimore on the construction of the W. B. & A. He also made a study of the physical properties of several mid-western utilities. Born in Cleveland, Mr. Doyle was 53 years of age.

Equipment Advancement Recorded at 1929 Road Show

New Machines Illustrate Trends of Modern Road Building Practice—Number of Exhibits Passes 400 Mark and Increases 20 Per Cent Over 1928

Engineering News-Record Staff Report

Part I

THE 1929 Road Show held January 14-18 in Cleveland eclipsed all previous ones, at least in size, by a wide margin. It is indicative of modern times that the same statement with a change only in the date has been applicable to every Road Show during the past decade. For instance, to go back only a few years, the following number of exhibits have been shown: 287 in 1925, 288 in 1926, 305 in 1927, and 338 in 1928. This year in spite of this constantly increasing rate of growth which might have been expected to sag and in spite of numerous consolidations among the manufacturers of construction equipment, there were 406 exhibitors, some 385 of whom were manufacturers of road building equipment or materials. The exhibits represented about 500 freight car loads of equipment and materials and when in place occupied the entire 8 acres of floor space available in the several buildings forming the Public Auditorium group. Registration of visitors to the show totalled something over 20,000.

Since the 1928 show Cleveland had completed its public auditorium, making it possible to hold the convention sessions of the American Road Builders Association in the same building with the exhibits—a decided advantage in many respects. No decision has yet been reached as to the location of the 1930 road show. Cleveland would like to have it returned, and there was much activity on the part of Atlantic City representatives to have the road builders come to that city's new auditorium.

Special exhibits showing road systems and programs were maintained by the American Association of State Highway Officials, Alaska, Mexico, the U. S. Department of Commerce, the U. S. Bureau of Public Roads, and the states of Idaho, Ohio, Pennsylvania, South Carolina, North Dakota, and Virginia.

Before reporting details a few general observations on the show as a whole can be made.

Trends of Improvements

As year by year road building and construction operations become more thoroughly mechanized, the trends in equipment design seen at the Road Show become better indices of changes and advancement in job practices. For instance, it has been rather generally assumed that the use of ready-mixed concrete is increasing. The unusually large number of special bodies shown for transporting ready-mixed concrete was substantial evidence that the assumption is well founded. On the other hand, the fact that some of the bodies are designed merely to prevent segregation of concrete mixed at a central plant while others actually mix the concrete en route, indicates that this development is still in a state of flux which in 1929 may turn to one or the other of the extremes, or take an entirely different line of growth. Again, much has been heard of proportioning aggregates by weight. This year every manufacturer of proportioning equipment showed a weighing batcher of some kind. As pointed out and stressed in the January 3 issue of *Engineering News-Record*, the time has arrived when the highways must be developed with a view toward furnishing the maximum of service to traffic. An increased number of exhibits containing equipment useful to increased highway service leads one to believe that the manufacturer fully appreciates this modern necessity. As examples, there were shown new machines for forming and maintaining shoulders on all types of roads, a new concrete finishing machine designed to insure easier riding qualities at high speeds, many new and improved designs of motor patrol maintenance graders, asphalt patching plants, snow equipment and signs and traffic signals in increased number.

Motive power is undergoing a change. There was only one steam power shovel at the show and no other steam equipment. And whereas gasoline power still dominates the prime mover field, the Diesel engine is slowly developing into a real competitor. A significant statement was made by one manufacturer of power shovels who said, "Our principal activity during 1929 will be the merchandising of Diesel engine powered shovels and cranes." This manufacturer in common with most of his competitors has offered Diesel powered equipment as an alternative for a number of years. His decision to make Diesel equipment a major item in his selling plan shows that he sees the time arriving when it can compete on a profit return basis with other forms of motive power. A Diesel-electric shovel was exhibited by another manufacturer, a Diesel locomotive by a third and two engine manufacturers showed Diesels, one of which attains a speed of 1,000 r.p.m. and weighs only about twice as much as a gasoline engine of the same horsepower.

Mechanical development of all machines leads naturally toward more automatic operation. Systems similar to the one inaugurated by a paver manufacturer three years ago in which the movement of one lever places in operation the whole series of movements incidental to charging, mixing and discharging the concrete, have been adapted by several other paver manufacturers on their 1929 models. The centrifugal pump with all of its advantages has always been troublesome on a job where the sump would sometimes run dry; the showing of several self-priming centrifugal pumps points to a solution of the difficulty. Snow plows and bulldozers are being operated by air or by power take-offs instead of manually. Truck dump bodies, both side and rear types, reduce hand shoveling, and an increased development in chip and gravel spreaders is working toward the same end.

Once in a while machines embodying substantially new ideas are shown. Such was the case this year with excavators patterned after elevating bucket loaders, a machine running on the road forms which shaved the subgrade and carried the spoil on a belt conveyor to a point outside of the pavement area, and a concrete pavement finisher which rolled rather than screeded the concrete. A truck body with a belt conveyor bottom was also a piece of equipment that belongs in this class.

Growth in refinements were as usual in evidence. A trenching machine with automotive type transmission and operating gears was an outstanding example. Pressure lubrication from a central point was introduced on several machines. Oil filters, air filters, steel castings on the heavy machines and arc-welded structural steel on those where weight was a detriment, ball and roller bearings, cut gears running in oil and silent chains were seen both on the machines and in special exhibits. An important development which can be characterized as a refinement is the increasing use of crawler units on trailer dump wagons. Last year there were three exhibits of such equipment; this year there were seven.

The foregoing gives only some of the more evident trends. Others will be seen in the detailed account of the exhibits which follows. In order to present these exhibits in some logical arrangement, they have been grouped under four general heads: (a) grade preparation, (b) paving and surfacing.

(c) transportation of materials, (d) service facilities, and (e) miscellaneous. Important new equipment is specifically mentioned while the names of all exhibitors are given with the idea that this report may serve as a reference to all leading manufacturers of roadbuilding equipment.

Grade Preparation

Power Shovels, Cranes and Buckets—As a class power shovels did not develop a general trend of improvement. Individually, however, there were a number of important advancements shown. Northwest Engineering Company showed its Model 2 skimmer, and its Model 4 1-yd machine in both shovel and crane types. The Model 4 machines were equipped with a new "close-quarter" cable crowd and the recently announced variable-speed gasoline engine. This close-quarter cable crowd does not replace the company's standard cable crowd, but supplements it as an attachment useful where a short boom and long stick are desired. It enables the bucket to be extended out to the limits of the stick independently of the hoist, either before, during or after hoisting. With this crowd the hoist may be held in any desired point while the bucket is thrust in and out. The new accelerator-controlled engine is said to be a radical departure from the usual fixed-speed engine. Special manifolding and carburetion devices have been developed which give an engine which will pull efficiently at any speed between 450 and 1,200 r.p.m. and at the same time will respond reliably to sudden changes in speed, thus making it similar in operation and flexibility with steam powered machines. Traveling is also aided by the variable-speed feature.

The Harnischfeger Corporation exhibited its Model 600 1-yd. machine powered by a Buda M.A.N. Diesel engine of 85 hp. The power plant for this company's Model 700 1¼-yd. shovel, a 7½x10½ Atlas-Imperial Diesel, was also shown. It is this company's intention to concentrate on the selling of Diesel powered excavators during 1929. The Marion Steam Shovel Company exhibited a 1½-cu.yd. Diesel-electric shovel as compared to the gas-electric shovel exhibited last year. A gas-electric generating unit only was included in the Marion exhibit. The Diesel-electric principle includes no radical change from the gas-electric, both involving the use of an internal combustion engine running at constant speed driving a direct-current generator which supplies current for three direct-current motors geared respectively to the hoist, swing and crowd. An example of refinement in shovel design was illustrated by the Ohio Power Shovel Company which exhibited its Lima "101" 1¼-yd. shovel featuring a total of 62 anti-friction bearings. In addition there are no chain drives in the machine and all gears are inclosed in oil-tight cases. Alemite lubrication is standard and all grease leads to the truck frame are brought to one position at the rear of the truck, where the operator in a standing position can lubricate the machine in a few minutes.

In the small shovel field, the Insley Manufacturing Company introduced a new ½-yd. full revolving gasoline shovel featuring the use of hydraulic control of the crawlers effective either with the clutch out or in. A ⅜-yd. machine was shown by the Universal Power Shovel Company of the full revolving type, utilizing a power boom hoist and an "airplane control" which permits operation of all movements of the shovel simultaneously. A new ¼-swing shovel powered by a McCormick-Deering power plant was also shown. Bay City Dredge Works exhibited a new small revolving machine with ⅜-½-yd. bucket weighing 13 tons, utilizing manganese steel castings for the car body and base, and featuring the elimination of all machinery below the car body. The company also exhibited a tractor shovel built around the McCormick-Deering tractor and mounted on full crawlers.

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Part II—Road Show Report

In the larger class this company exhibited a ¾-yd. full circle machine with the base of its boom only 30 in. from the center pin, which is claimed to give unusual stability. The Orton Crane & Shovel Company exhibited a new ⅜-yd. shovel featuring a gear-driven crowding mechanism operated and controlled entirely independent of the hoist and transmitting the full power of the engine to the dipper teeth. This new shovel also places the operator in a cab extension out in front of the machine where he has a clear view to both sides. A new Orton crane utilizes centralized Alemite lubrication, an electric welded boom, an electric welded base, spring type flexible crawlers and a roller bearing swing. This company's pull shovel attachment was driven by differential drums placed on top of the boom and said to give increased pull-back power. The Universal Crane Company exhibited its new Model 35, being a two-speed center drive crawler of ½-yd. capacity which utilizes the Thew center drive crawler and boom and the Universal Crane Company's power plant and superstructure.

The Thew Shovel Company exhibited a 1½-yd. center drive shovel and a similar machine fitted with the new back digger bucket. This company also showed a new Lorain 55 1-yd. clamshell crane-shovel, utilizing the advantages of the company's center drive truck. Features of these machines are an automatic crowd brake that holds the dipper stick in any position without back drift and a patented dipper trip engaged by a push from the shovel operator's elbow. The new ¾-cu.yd. crawler shovel-crane shown by the Link-Belt Company featured one piece annealed lower frame and revolving base, chrome steel crawler treads and bronze bushed crawler rollers. This company also showed a new 2-yd. shovel. The Koehring Company exhibited a 1½-yd. shovel fitted with ball bearings on all high speed shafts and with roller bearings on its vertical traction and swing shafts. Industrial - Brownhoist Corporation showed a new 1-yd. gas shovel crane utilizing an electric welded steel frame and outside dipper sticks, with a 6½-ton capacity when used as a crane. The Bucyrus-Erie Company showed four machines, a high-lift steam shovel, a gas-plus-air shovel, a new Diesel drag shovel and a new ½-yd. gasoline crane, designated as its model 1020.

The Byers Machine Company showed its 1½-yd. shovel with increased horsepower, a new and simplified chain drive crawler and single steel castings for the frame and car body. This company's small shovel, the "Bulldog" was also exhibited. The Moore speed crane featuring the use of a selective gear shift, a full floating rear axle and only 16 gears in the entire machine was shown by the Manitowoc Engineering Works. The Osgood Company exhibited a new model known as the "Commander" featuring two speeds for hoist, swing and travel, with all horizontal shafts riding on roller bearings. The Conqueror and Victor models of this company were also shown. The Keystone Driller Company exhibited its excavating machine fitted with both skimmer and pull scoops, the latter in 20, 32 and 44 in. sizes. New features on this company's machines include an increased use of arc welding fabrication and fins on the drum which contribute to efficient operation by absorbing the heat of friction. Star Drilling Machine Company exhibited its "boomless" power shovel fitted both with a skimmer and with ditching equipment. Mead-Morrison Manufacturing Company exhibited its "Giant" ½-yd. machine utilizing a ⅜-yd. dipper, automatic brakes eliminating the use of foot brakes of any sort, and a "live" boom which may be raised or lowered without the use of foot brake, ratchet or pawl. The General Excavator Company, the American Hoist and Derrick Company and the Speeder Machinery Company also exhibited their power shovels and cranes.

Excavators built around McCormick-Deering power plants were shown by the Hanson Clutch Machinery Company and by W. M. Blair Mfg. Company.

Truck cranes were shown by the Universal Crane Company and the Browning Crane Company. The Universal Crane Company showed a 6-ton machine with a 28-ft. boom and with 4, 8, 12 and 16 ft. boom extensions as well as a ½-yd. clamshell bucket attachment. The six-wheel detachable Christie crawler unit for these truck cranes was exhibited. The Browning Crane Company showed its crawler mounted crane and in addition a new eight-wheel drive unit applicable to all makes of trucks and known as the Browning-Christie eight-wheel drive. It is claimed to be capable of pulling a

truck under almost any road conditions but special detachable crawlers are provided as extra equipment.

Page Engineering Company exhibited a new drag shovel attachment in which the bucket is hinged to the bucket arm, making it possible to dig crosswise of a trench as well as lengthwise, to dig at any angle and to finish long flat bottoms without moving the machine. It is available in ½, ¾ and 1 cu.yd. sizes.

Two new clamshell buckets were exhibited. The G. H. Williams Company showed a ½-yd. bucket for light cranes with the sheaves placed in tandem on the power arms, giving a straight line closing pull and in effect combining the advantages of the lever and the block-and-tackle type of bucket. The new clamshell bucket shown by the Lakewood Engineering Company featured an unusually wide spread with no increase in headroom, the use of alloy steel bushings, a center casting assembly connected to the head of the bucket by a heavy chain so as to absorb the shocks from sudden opening, Alemite lubrication and cast steel hinges integral with the center barrel assuring shell alignment. Buckets were also shown by the Owen Bucket Company, Blaw Knox Company, Erie Steel Construction Company and by the Hayward Company.

Grading Machinery—As with power shovels the improvements in grading machinery have been individual rather than collective. However, there is a discernable tendency to apply power to grader operation, both for traction purposes and for operating the blade lifts. An outstanding example of the first type was shown by the Austin-Western Road Machinery Company in its new dual drive motor grader built around a McCormick-Deering 10-20 tractor, this machine having four rear drive wheels. This company's exhibit also contained a leaning grader with scarifier and a motor grader on a Cletrac tractor. The Ryan Mfg. Company, which has recently consolidated with the C. D. Edwards Company, exhibited its motor-controlled leaning frame grader on which all manual operations incident to moving the blades or adjusting the frame for ditch cutting are eliminated.

A Ryan dual-blade patrol grader was also exhibited, dual blades being useful in reducing washboard surfaces on gravel roads. One of the largest machines exhibited was the new adjustable leaning wheel grader, No. 14, shown by the J. D. Adams Company, which utilized a 12-ft. blade and a specially rigid frame construction in which the usual cross bracing is supplemented by four large tubular cross members riveted between the two frame beams by means of heavy flanged castings. A large ball and socket joint in the front truck replaces the fifth wheel so that the front truck has entire freedom of movement to ride over the ground without subjecting the front end of the frame to any twisting strain. A special gear reduction for the blade control gives a leverage equivalent to the use of 128-in. handwheels of the old type. Alemite lubrication and Hyatt roller bearings are standard equipment.

An unusual machine was shown by the Banting Manufacturing Company known as its Greyhound power scarifier and designed as a 3 in 1 machine for scarifying, grading and rolling. The weight of the machine is about 20,000 lb. The motor patrol grader exhibited by the Minneapolis Steel & Machinery Company featured a special design of blade handling made possible by the elimination of the revolving center circle. The blade is carried on two members attached to the side frame, the side members operating from a ball and socket joint at their forward end, raising, lowering and moving sideways with the changing position of the blade. Thus regardless of the angle at which the blade is operated, the power is transmitted on a direct line to the cutting edge. The Good Roads Machinery Company exhibited a new "Autograder," a completely new patrol grader following automotive design principles in all mechanical details. Other grading machinery was shown by the Stocklard Road Machinery Company, the Rome Manufacturing Company, the Russel Grader Manufacturing Company, the Galion Iron Works & Manufacturing Company, Little Red Wagon Company, Wehr Company, W. A. Riddell Company and Shaw-Enochs Tractor Company.

Sidelights on the Show

EASIER operation either by power or reduction gearing characterizes modern grading equipment.

PORTABLE air compressors have been extended to a 360-cu.ft. capacity.

Rollover or rotary scrapers were shown by the Sidney Steel Scraper Company, Roderick Lean Company, Euclid Crane & Hoist Company and the Baker Manufacturing Company. The latter company also showed a self-loading scraper and a new one-man automatic road maintainer, being a multiple blade machine which scrapes a path 9 ft. wide in maintaining earth, gravel, oiled or sand clay roads. The Killifer Mfg. Company showed a revolving scraper in a 2½ cu.yd. size. In addition to this machine a cable laying machine and a road ripper, being a trailer scarifier, were also exhibited by this company. The Ward Plow Company showed several designs of road plows. The Ball wagon grader was shown by A. W. French & Company who have taken over its manufacture. It is a tractor pulled machine consisting of two mechanically operated loading and carrying buckets of 40 cu.ft. capacity each with crucible plow steel cutting bits followed by a drag blade also lever-operated by the man on the grader. A. W. French also exhibited a "Nu-method" finish grader, a self propelling machine operating on the road forms which by means of mechanical scrapers cuts the subgrade to proper elevation and crown and by means of a belt conveyor carries the spoil material outside of the forms.

Spring scrapers for under-truck attachment were shown by the Willett Manufacturing Company and the Root Spring Scraper Company, the latter being of the hydraulic reversible type.

Road Rollers—In the Austin-Western Road Machinery Company's exhibit was a new 5-ton motor roller of unusually short wheelbase and with three speeds forward and reverse. A 10-ton motor roller equipped with scarifier was also shown. Five to 10-ton motor rollers were exhibited by the Huber Manufacturing Company, the Wehr Company, the W. A. Riddell Company and the Galion Iron Works & Manufacturing Company. The Buffalo - Springfield Company in addition to showing its large motor roller exhibited a new four-cylinder tandem 2½-ton roller for use on shoulders and also suitable for rolling brick pavements which are laid with the shortest dimension vertical. The Pierce Governor Company exhibited the smallest rollers at the show, the models consisting of ½, 1½ and 3-ton machines. A newcomer in the motor roller field was the Ames Iron Works Division of Pierce, Butler & Pierce Manufacturing Corporation, which showed a new 6-cylinder 10-ton roller featuring single lever control for forward and reverse motions, three speeds forward and reverse, and a pivoted front roll designed to eliminate swaying of the front end of the roller.

Air Equipment—Portable air compressors, the nucleus of pneumatic machinery on road work, have in large measure become standardized according to designs of the several manufacturers. Thus there is not much visible change although each year sees new refinements and detailed improvements. This year Schramm, Inc., in addition to its usual line of compressors, exhibited a 4-cylinder 360 cu.ft. machine, claimed to be the largest portable compressor yet built and to have been made practicable only by the use of a heavy duty self-aligning clutch-type coupling between the engine and the compressor. Portable compressors, air tools, forges and drill sharpeners were exhibited by Sullivan Machinery Company which also showed a new pavement testing core drill, by Ingersoll-Rand Company, Chicago Pneumatic Tool Company (showing a new 310 ft. machine), by Metalweld Inc. (showing its new McCormick-Deering 160 cu.ft. tractor compressor), by Pontiac Tractor Company (exhibiting its self-propelling compressor mounted in front of a McCormick-Deering tractor on an extension frame) and by Independent Pneumatic Tool Company which exhibited a new Thor 250 cu.ft. portable compressor equipped with the "Rix Supercharger" which enables the piston on its idle or down stroke to compress the additional air which the machine delivers. A new pneumatic concrete

grinder was also shown by this company. The Buhl Company showed portable compressors from 36 to 300 cu.ft. per minute capacity, while the O.K. Clutch & Machinery Company showed a gas engine driven compressor unit mounted on the rear of a motor truck. Gardner-Denver Company in addition to its 160-cu.ft. portable compressor showed a new steel stoper and a new high pressure furnace claimed to be noiseless in operation.

Culverts—Culverts were exhibited in practically all of the types in use today. Spiral corrugated culverts of cast iron were shown by the American Castings Company. The Toncan Culvert Manufacturers Association exhibited corrugated culverts, perforated drains and fittings, all utilizing Toncan copper-molybdenum iron. Armco Culvert Manufacturers Association exhibited perforated iron pipe for sub-drainage and culvert pipe with paved inverts of bitumen in addition to its various special fittings, all made of Armco pure iron. Precast concrete culverts were shown by the Universal Concrete Products Company and by C. A. Belknap, the latter with collars at each end.

Trenchers and Excavators—Unusual activity was displayed in this field, practically every manufacturer exhibiting a radically improved machine. The Parsons Company exhibited a new ladder type machine claimed to be the largest ditcher yet placed on full crawlers. Its entire main driving mechanism is inclosed in oiltight cases and anti-friction bearings both ball and roller type and cut and case-hardened gears are used extensively. The boom is adjustable transversely so that the machine ditches from 18 to 48 in. wide and in depths up to 12 ft. The Cleveland Trencher Company in addition to its wheel type Baby Digger and its Pioneer model, featuring a 180-deg. pivot conveyor, showed a new curb trench attachment consisting of a small ladder trencher which replaces the wheel on the Baby Digger. The Industrial-Brownhoist Corporation showed an improved Topping Pony ditcher which will dig from 13 to 30 in. wide up to 7½ ft. deep. It features nine forward and three reverse speeds, full crawler mounting, a modified one-shot lubrication system and an arc-welded frame. Ladder type ditchers and small backfiller cranes were shown by the Austin Machinery Corporation and the Buckeye Traction Ditcher Company.

The Haiss Manufacturing Company showed a new excavator and road grader designed for making long shallow excavations without the necessity for preliminary preparation such as plowing and scarifying. It is of the bucket dredge type with an extended foot shaft on which are placed digging picks and inclined feeding propellers. The Barber-Greene Company showed its vertical boom ditcher and a new belt car-unloader, the latter being a small bin conveyor for taking sand and gravel out of railroad cars and feeding it to another machine. However, the new machine in the Barber-Greene booth was a new excavator consisting of a heavy chassis mounted on crawlers with four Barber-Greene vertical booms. The excavator is claimed to be the only machine which in excavating the material prepares it for other uses, that is, this machine discharges the material at the end of the conveyor in the form of ground-up material suitable for all kinds of filling. In digging it has a range of adjustments between 1 in. and 7 ft.

Paving and Surfacing

Aggregate Handling Equipment—The heading of aggregate handling equipment covers a wide range and includes crushers, screening and conveying equipment, bins and batchers. Although belt conveyors have been much used in transporting materials over considerable distances the type of conveyors shown at the show are those generally used in and around central mixing plants.

An unusual operating exhibit was maintained by the Allis-Chalmers Manufacturing Company in the form of a huge 14-in. gyratory crusher with a capacity of 382 tons per hour of which 85 per cent will pass a 3½ in. screen, or 99 tons per hour of which 85 per cent will pass a 1⅛ in. screen. The machine is self-contained with a vertical motor. The Williams Patent Crusher & Pulverizer Company exhibited a special crusher for use with wet, muddy rock as well as a large crusher for handling one-man size stone. Jaw crushers were shown by the Universal Crusher Company, the Wheeling Mold & Foundry Company and the Bakstad Crusher & Engineering Company, Inc., the latter exhibiting a three-jaw crusher, the three jaws being placed in series, thus making it possible to produce three different sizes of stone.

The Smith Engineering Works exhibited operating models of sand and gravel washing plants and rock crushing plants. A new re-washer of the screw type was exhibited by this company. Vibrating screens were exhibited by the Smith Engineering Works, Simplicity Engineering Company, the Productive Equipment Corporation, the Niagara Concrete Mixer Company, the W. F. Tyler Company and the Traylor Vibrator Company. The latter company exhibited a new vibrator conveyor which conveys materials along a steel trough by means of rapid pulsating electric vibrations. The capacities vary from 50 to 200 tons per hour, and conveying surfaces are made in widths of 20, 30 and 40 inches, and in lengths ranging from 8 to approximately 30 feet. Screening equipment was also exhibited by the Wisconsin Foundry & Machine Company, and by the Pioneer Gravel Equipment Manufacturing Company.

In the fields of belt and bucket conveyors no radically new developments were exhibited. Manufacturers exhibiting this type of equipment comprised the following: N. P. Nelson Iron Works, Barber-Greene Company, Link-Belt Company, Chicago Automatic Conveyor Company (portable belt conveyor with a double-deck shaker screen for separation of three sizes of material), Burch Corporation and the Haiss Manufacturing Company. The O.K. Clutch & Machinery Company also exhibited a portable elevator for use in building construction.

Equipment for proportioning concrete aggregate has annually presented new developments. This year was no exception, an outstanding tendency being noted toward the use of various designs of weighing equipment. The Blaw-Knox Company showed a 51 ton portable two-compartment bin equipped with a 5000-lb. double weighing batcher, the weighing hopper and scale being transported as a unit with the bin. In this weighing batcher the poises are set for the weights of the various aggregates and need never be moved thereafter until it is desired to change the proportions or to make a change in the moisture correction. A charging bin for storage and batching loose cement was also exhibited. A new triplex gate for use with three compartment bins in charging two sizes of coarse aggregate was also shown by this company. Heltzel Steel Form & Iron Company showed bins of 35 and 50 ton capacity, improved by extra bracing and by the use of a 50-deg. slope. The company's duplex weighing Agrabatcher was shown with a capacity in the stone compartment of 3000 lb. and in the sand compartment of 2000 lb. An important feature of this weighing batcher is that it is equipped with an automatic springless dial scale having a 36-in. dial graduated to 5,000 lb. in 5-bl. graduations. Pointers which can be set at the weight of sand and stone, and a third pointer set at the weight of combined sand and stone, assist the operator in rapid weighing.

The Erie Steel Construction Company exhibited a 60 ton bin equipped with its new combination volume-weighing Aggremeter. The equipment utilizes a large beam graduated in 100 lb. units, an auxiliary beam in units of one pound, and an auxiliary dial scale used to show the approach of the weight to the desired amount. Other companies exhibiting batchers were the R. H. Beaumont Company showing copper-steel bins with volume batchers, the Butler Bin Company showing a 40-cu.yd. two-compartment bin with weighing hoppers and all steel scales, and C. S. Johnson.

Concrete Mixers—Although many

Sidelights on the Show

NEW conceptions in excavators are here utilizing digging bucket chains.

AGGREGATE batching by weight is increasing.

PAVERS are becoming faster and more nearly automatic in operation and more accurate in water control.

different sizes of mixers were shown at the show, pavers in the 27-E size were accorded the most attention. The trend of improvement is toward faster and more automatic operation at the same time securing increasingly more accurate water control. The 27-E paver shown by the Koehring Company is said to have redesigned in every particular. Features are an unusually low height making a collapsible upper structure unnecessary, the use of roller and ball bearings on every shaft including even the pulley sheaves, an oscillating boom which permits the bucket to hang perpendicularly regardless of the incline of the paver and an automatic mixing cycle. Beneath the drum which is 5 in. larger in diameter is a heavy steel casting inclosing the traction gear and final gear drive. On this casting are mounted the transmission case, drum rollers and connecting shaft, worm driving pinions and drive shaft, each unit inclosed in a separate casting. Such a foundation is claimed to practically eliminate all vibration. The 1929 paver is made about 9,000 lb. heavier than the 1928 model. The T. L. Smith Company exhibited an improved 27-E paver incorporating automatic operation of water and discharge chutes, a power boom swing and a water measuring tank claimed to be accurate to the ounce. A chain compensator or equalizer cable is used on the charging skip which gives a four-part line for the first half of the lift of the skip; thereafter the skip is pulled to its highest position by the usual two-part cables. This company also exhibited a 7-S tilting mixer with a vertical water measuring tank claimed to be as accurate as those used on the pavers. Ransome Concrete Machinery Company exhibited its 27-E paver with a new calcium chloride tank attachment, automatically operated as the skip is raised. This company also had the largest mixer at the show, an 84-S central plant. Chain Belt Company exhibited its 27-E paver equipped with its "mechanical man" which automatically performs the complete cycle of mixer operations. A power boom swing has been added and a new valve placed on the water tank which eliminates all possibility of bypassing, since the inlet and outlet are operated in sequence by a single motion of a lever. The improvements on the 27-E paver of the Foote Company include a speeding up of the discharge and travel, the elimination of the bail on the skip and the use of a heavier frame, a 4 in. longer drum, larger discharge openings, and a new vertical water tank of the pressure-plunger type. In addition building mixers were exhibited in sizes ranging from 3½-S up to 21-S by the Knickerbocker Company, the Jaeger Machine Company, the Leach Company, the Construction Machinery Company, the Republic Iron Works, the Kwik-Mix Concrete Mixer Company, and the Lakewood Engineering Company.

Finishing Machines and Road Forms—No important changes have been made in road forms. Exhibitors included the Blaw-Knox Company, Heltzel Steel Form & Iron Company, Truscon Steel Company and the Hotchkiss Steel Products Company. In the field of finishing machines important improvements were noted. Lakewood Engineering Company exhibited a bridge type machine similar to the conventional finisher but carrying a longitudinal roller moving across the roadway between the forms. It is claimed to give all of the benefits of a longitudinal float at the same time removing excess water and laitance, and serves as a continuous straight edge to check the smoothness of the surface. It also acts as a continuous template to check the crown and gives the surface 50 or 150 ft. back of the mixer a final squeezing to bring it to absolutely true contour. Heltzel Steel Form & Iron Company exhibited its "flex-plane" machine, a combination finishing and joint forming machine. The model shown at the show made both transverse and longitudinal joints by means of inserting collapsible steel plates into the freshly poured and finished pavement. A. W. French & Company exhibited its Ord concrete road finisher featuring the double sliding screen.

Sidelights on the Show

FINISHING concrete pavements by a longitudinal roll instead of a transverse screed is a new development.

BITUMINOUS materials have entered the field of concrete curing agents.

Pumps—The large triplex road pumps introduced several years ago continued as an important part of a number of manufacturers' exhibits. Only in detail were any of them changed from previous designs. The same can be said of diaphragm pumps and of the combination lift and force pump. Several manufacturers showed force attachments for ordinary diaphragm pumps. A. S. Marlow exhibited a 4-in. single open-discharge diaphragm pump in a new side outlet pattern and a new 4-in. centrifugal pump outfit powered by a 10-hp. gasoline engine. A new product exhibited by the Domestic Engine & Pump Company was a self-priming centrifugal pump utilizing a special vacuum pump and vacuum chamber which permitted the pump to pick up water after any period of dryness. The Homelite Corporation exhibited its portable gasoline driven centrifugal pump which weighs only 75 lb. in a new self-priming model. It, too, can be used either for volume or for seepage pumping. Other exhibitors of pumps included the Morris Machine Works, Ralph B. Carter, John Lauson Manufacturing Company, Humphryes Manufacturing Company, C. H. & E. Manufacturing Company and the Barnes Manufacturing Company.

Pavements and Surfaces—Concrete pavements were officially represented by the Portland Cement Association, brick pavements by the National Paving Brick Manufacturers Association and asphalt pavement by the Asphalt Association. Two cement manufacturers exhibited and both of these showed cement of special characteristics, Atlas Lumnite Cement Company showing its alumina cement and the International Cement Corporation exhibiting "Incor" its recently developed high early strength portland cement. Road reinforcing of mesh, bars and built up units were exhibited by a number of manufacturers. Among them were the Wickwire Spencer Steel Company, Concrete Steel Company, Electric Welding Company, National Steel Fabric Company, American Steel & Wire Company and the Truscon Steel Company. Irving Iron Works exhibited its combination armor and reinforcement for bridge floors and the Blaw-Knox Company also exhibited a concrete embedded floor armor, the American rights for which it has recently obtained from an English concern. Alan Wood Iron & Steel Company exhibited its steel traffic treads for use on top of wood bridge flooring.

Expansion joints and special roadway accessories were shown by W. R. Meadows and by the Philip Carey Company; both of these companies showed asphalt plank bridge flooring and the latter company exhibited its "Elastite" rail filler and its track pavement, consisting of special shapes of track insulations for grade crossings.

Special asphalt paving products were shown by the Natural Rock Asphalt Corporation, James C. Berry's Sons Company, the Amiesite Asphalt Company of America, the Texas Company, the American Tar Products Company, the Bitumulos Corporation, and the West Process Pavement Company. The Hastings Pavement Company exhibited compressed asphalt paving blocks.

Calcium chloride for curing, for set acceleration and for dust proofing was shown by the Dow Chemical Company, the Pittsburgh Plate Glass Company, and the Solvay Sales Corporation. Grasselli Chemical Company explained the uses of its silicate of soda as a road curing agent. Celite Products Company, now a division of the Johns-Manville Company, included in its exhibit slump test cones, strength charts and workability tables designed to show the advantages both to strength and workability of using its special diatomaceous earth as a concrete admixture. Curing concrete by sealing it with a bituminous coating which is a comparatively new development, was exemplified by McEverlast, Inc., which showed its "Hunt" process, for spraying the pavement with a preparation made up principally of lake asphalt and gilsonite, and by the Barber Asphalt Company, which exhibited its "Curcrete," an emulsion of bitumen. The latter company exhibited a curcrete machine, consisting of pressure tank, air compressor and spraying nozzles.